FEBRUARY, 1953

PETROLEUM REFINER

Specialized for Refining, Natural Gasoline, Petrochemical Engineering, Operations and Management.

Cat Cracker Turnaround

•

New Ethylene Oxide Process

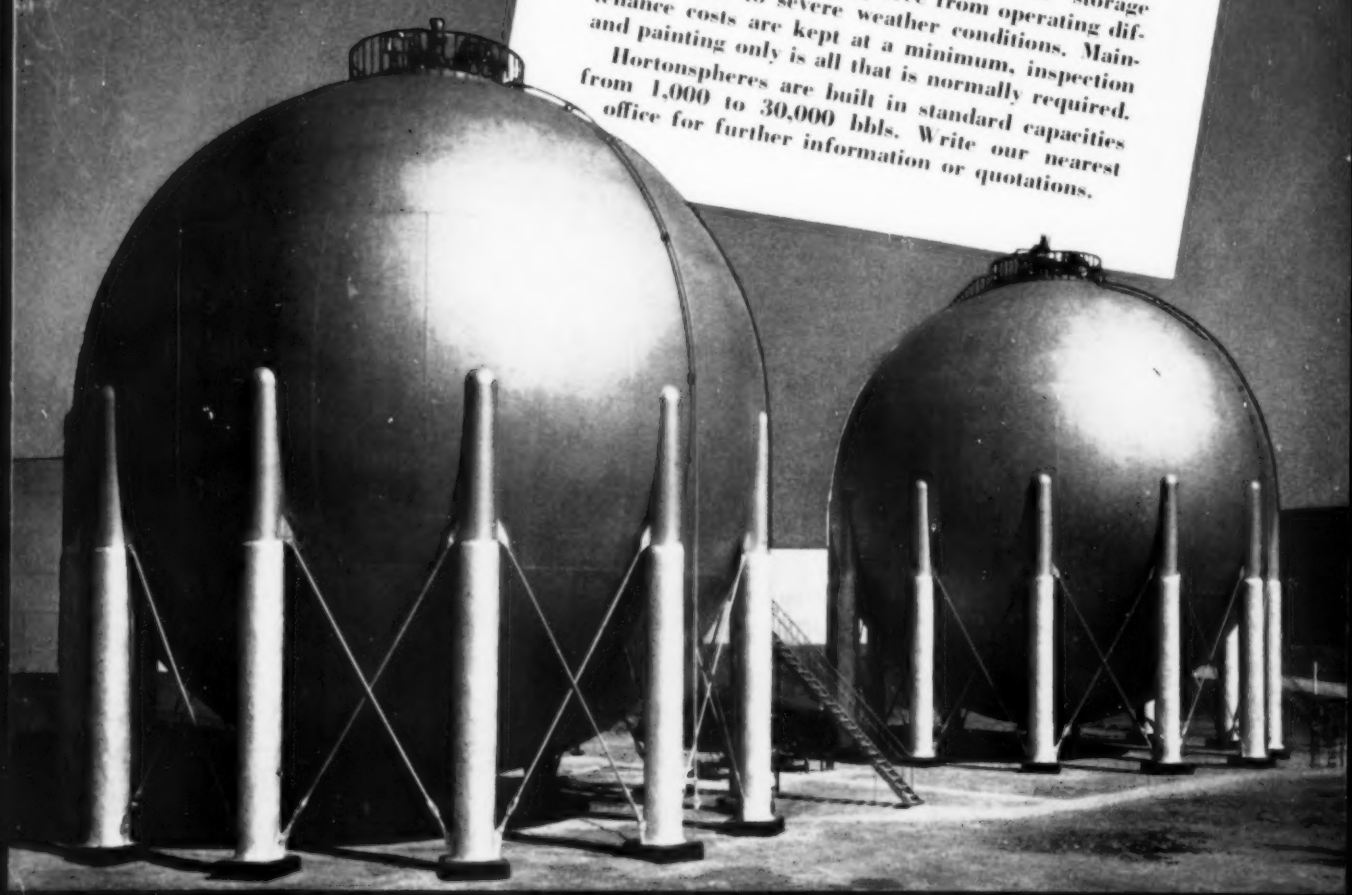
•

for a Quick Look at this month's contents—Page 2

The ideal shape for the storage of liquids under pressure is a sphere. From this shape comes the Hortonsphere, best adapted to the storage of the more volatile liquids such as butane, butane-propane mixtures and volatile refinery stocks.

Hortonspheres provide dependable storage service. They are entirely free from operating difficulties due to severe weather conditions. Maintenance costs are kept at a minimum, inspection and painting only is all that is normally required.

Hortonspheres are built in standard capacities from 1,000 to 30,000 bbls. Write our nearest office for further information or quotations.



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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, and GREENVILLE, PENNSYLVANIA

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puts the HEAT on heat exchangers

By changing to Yarway Impulse Steam Traps, an oil refinery reports much hotter steam in their heat exchangers **—plus two other important extras:**

(1) They were able to operate the plant with 6 boilers instead of the 8 formerly required.

(2) Three men formerly required to service old-type traps can now be used for productive work.

Significant sidelight—these Yarway traps are operating under severe conditions, many outdoors with temperatures often below zero.

Plant after plant is standardizing on Yarway Impulse Steam Traps because Yarways are designed to deliver the most premium B.T.U.'s at top temperatures into your process or product. **They get equipment hotter, sooner . . . and keep it hot.**

Other reasons—small size, easy installation, good for all pressures, only one moving part, low maintenance, low price.

Buy your Yarway Impulse Steam Traps from the nearest of 216 distributors. For name, write us.

ACTUAL SIZE ¾" YARWAY STEAM TRAP

YARNALL-WARING COMPANY
128 Mermaid Ave., Philadelphia 18, Pa.

FREE OFFER. Don't take our word for it. Test Yarway's advantages in your own plant, without cost or obligation. Drop us a card or letter—a trial trap will be delivered promptly.

YARWAY the steam trap

designed with more production in mind

Volume 32, No. 2 February, 1953

PETROLEUM REFINER

Specialized for Refining, Natural Gasoline and Petrochemical Engineering, Operation and Management

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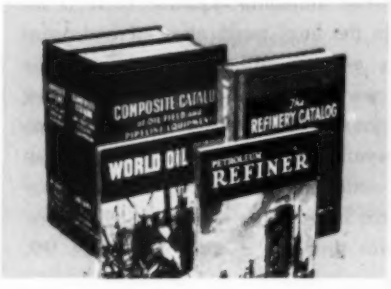


TURN the page for
A Quick Look
at this MONTH'S CONTENTS

A Quick Look at

PETROLEUM REFINER This Month

Why Are Compensation Insurance Rates Higher? Texas employers know the answers—more accidents and some unwise procedures in granting awards for injuries. Throughout the state, both in and out of the oil industry, employers are rallying behind a movement to have the compensation laws amended during the current session of the Texas Legislature. For an analysis of the situation which makes this legislation necessary, read this article on **Page 75.**

New Process for Ethylene Oxide by Direct Oxidation. This new method produces the highly reactive organic compound, ethylene oxide, by utilizing a fluidized catalyst bed. Yields of 55 to 65 percent based on ethylene are possible. The economics of the process make it competitive with the established chlorohydrin process which gives higher yields but requires chlorine and lime as additional raw materials. **Page 87.**

Improve Polyform Operations With These Correlations. You can increase polyforming and reforming capacity by using the original correlations in this article. A novel and ingenious relationship has been developed which relates the maximum allowable naphtha in the furnace charge to the severity of operation. The author offers ample plant data to back up his claim that, through use of the new correlations, capacity can be increased without sacrificing product quality. While developed for a polyformer, applications to other reforming processes are shown. Said an industry expert who previewed this article: "I have reviewed this paper carefully and find it to be excellent." **Page 91.**

Mexico's Sulfur Recovery Plant Second Largest in World. Mexico is now a net exporter of sulfur, having put into operation a 120-ton per day sulfur recovery plant. The plant recovers 99.9 percent sulfur from the weakest acid gas strength known to be so treated. It avoids expensive sulfur blasting by producing the mineral in easily broken ribbons. On initial startup the plant was brought to more than 90 percent of the design rate in just 24 hours. **Page 95.**

Thermal Insulation for Industrial Requirements—Part X. This highly popular series is concluded with the current installment. The insulation engineer-author details the needs of the insulation field and offers concrete recommendations for solutions to the problems. Chief difficulty in the past has been lack of standardization. Various groups are making progress in overcoming this shortcoming. College-trained engineers receive little help from their curricula in preparing them for some of their most important work. The case for more sympathetic understanding from management representatives is presented. **Page 97.**

Producing Ammonia Synthesis Gas. With the large expansion in synthetic ammonia capacity, there is increasing interest in the final purification of hydrogen-rich gas streams as the initial step in ammonia production. The new process described applies low temperature nitrogen washing not only to the production of ammonia synthesis gas but also to the production of streams containing 98 percent hydrogen or better. Approximate investment figures and utility requirements pinpoint this new application. **Page 99.**

A Quick Look . . .

Shell Combats Fires With Less Manpower, Equipment. Modern fire-fighting requires high mobility with a minimum of unwieldy equipment. Shell Oil Company has answered these needs by installing three "foam houses on wheels" at its Houston refinery. The units consist of two trucks and a trailer, each capable of mixing its own liquid foam and ejecting 12 streams of liquid at a rate of 125 gallons per minue through each outlet. For a picture story of the foam houses, see **Page 103.**

New Hydroforming Unit Produces Petrochemical and Avgas. Features of the brand-new petrochemical venture detailed in this article may very well be adapted to your own plant. Beginning with the initial design conditions, the authors give all essential data in tracing the development of the hydroforming and extractive distillation facilities. Flow diagrams, operating conditions, feed and product analyses and yields are shown for the production of toluene, benezene, and aviation gasoline. **Page 105.**

Design of Rectangular Footings . . . You can eliminate much of the usual tedious trial-and-error procedure in the design of stack and tower foundations. Here is a rapid graphical method for these designs. Last November this same author discusssed the design of square footings. We asked him to add this supplement so that you would have the complete story. **Page 110.**

Techniques for Cat Unit Turnarounds. Here is a "how-to" description of cat unit turnarounds. The second paper in our recently begun Maintenance Series, these timely tips on trimming thousands of dollars from turnaround budgets are *must* reading for refinery maintenance and management people. Advance planning methods, supervisory staff lineups, and manpower coordination are described by authors who have enjoyed conspicuous success at their own company. The use of power tools, straddle trucks, cranes, and other modern equipment to save dollars and speed work are given thorough treatment. Read it carefully and pass it around to your foremen. They're sure to profit. **Page 112.**

How to Select Compressors. Compressor buying is made simpler and easier through the wealth of facts and figures offered in this excellent paper. How do you choose between light, medium and heavy duty compressors? The answers lie in the efficiency of the distribution system and the air demand. The author spells out important check points to insure proper weighing of these variables. **Page 115.**

Statistical Quality Control—Applications and Limitations. Improve your operations by applying this new mathematical tool. In easily-understool, nontechnical language, the author tells engineers and operators how to obtain better performance from their units through application of this modern science. Octane numbers, boiling ranges, LPG components and end points are better controlled through the use of statistics. Sufficient information is contained in this article to get you in business at once. **Page 121.**

Catalyst Poisons and What to Do About Them. A panel of nine of the industry's top experts participated in a recent WPRA panel discussion of this top-interest problem. An exact transcription of the informal discussion is presented. You're sure to enjoy the style of presentation and may well find in the arguments and discussions the answers to your own problems on catalyst poisons. **Page 125.**

Measuring Employe Morale . . . An industrial executive said, "I know my people by their first names, lend them money when they're in a jam, ask about their babies. Attitude survey? I don't need it." Three months later his employes went on a strike, smashed every window in the plant and now the plant lies abandoned? How is the morale of your employe? Here is an authority with some mighty good suggestions for you. **Page 128.**

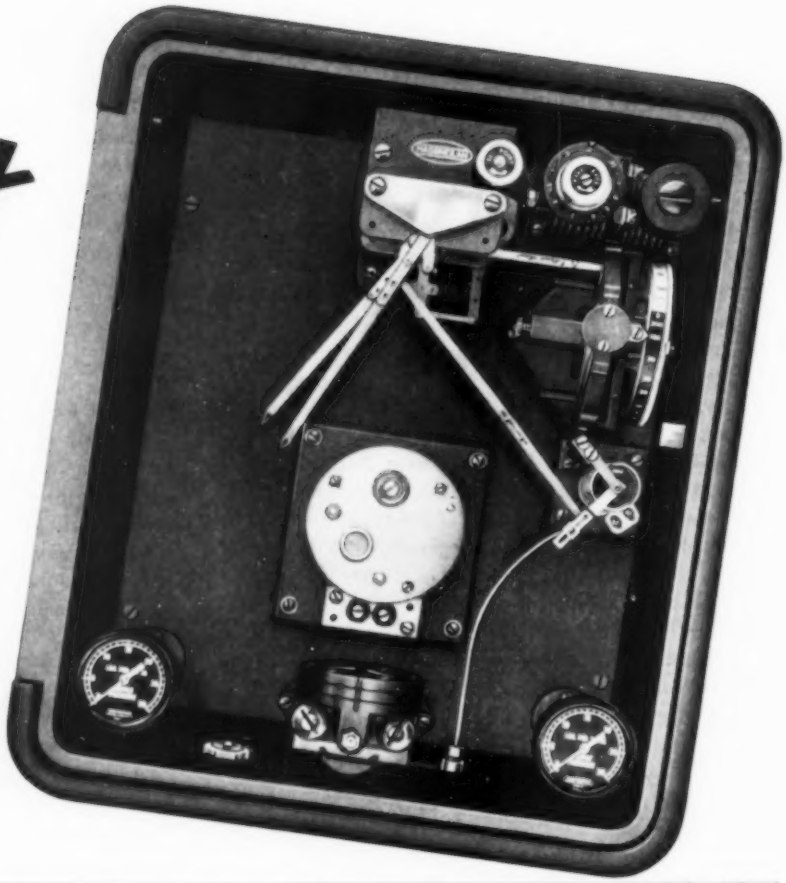
Dehydration of Natural Gas and Light Hydrocarbon Liquids. Is it economical to use natural expansion refrigeration? What kind of inhibitors should you use? Why? What process and equipment factors should be considered? Here, in part 5 of a series, you will find the answers to these questions, cost data, comparisons with other process and other information. **Page 131.**

Cat Cracking Capacity Increased by Unusual Methods. Management, engineers and operators will find absorbing this story of how Humble Oil & Refining Company tripled the capacity of its two cat crackers. With the aid of detailed pictures, the article gives a step-by-step accounting of engineering ingenuity and a blue-chip payoff. Keys to the successful program included an engineering study to pinpoint bottlenecks, modernization of the cyclones, and application of an entirely new concept in reactor design. **Page 135.**

Evaluating Viscosity Index Improvers. Follow the method outlined in this article and choose your viscosity index improver for any base stock, regardless of crude source. The special blending charts for this purpose must be prepared from data secured from actual blends of several different stocks with the additive to be investigated. **Page 139.**

See it Work

in your plant



Masoneilan 60000 Series Controller

Ask a Mason-Neilan engineer to bring a demonstrator model into your own office or plant — and see the difference. Note these outstanding qualities . . .

GIMBAL UNIT

See how *ONE CONTROL MECHANISM* gives you *FOUR COMBINATIONS* of primary and feedback motion to obtain Direct or Reverse Proportional (includes On-Off), or Differential Gap control.

SIMPLE ADJUSTMENT

Make only ONE SETTING — without removing chart — to select type of control, direction of action, and percent proportional band or differential-gap. See how easy to adjust, test and service, too, because all unit assemblies are directly accessible, easily detached, interchanged. Note how all air passages are manifolded.

STUBBORNLY DEPENDABLE

Accurate, stable performance, plus unequaled simplicity, versatility and reliability make the Masoneilan 60000 Series Pneumatic Controller the *Instrument Man's Instrument* for pressure, temperature, liquid level or flow control.

(Call in a Mason-Neilan engineer at your earliest opportunity)

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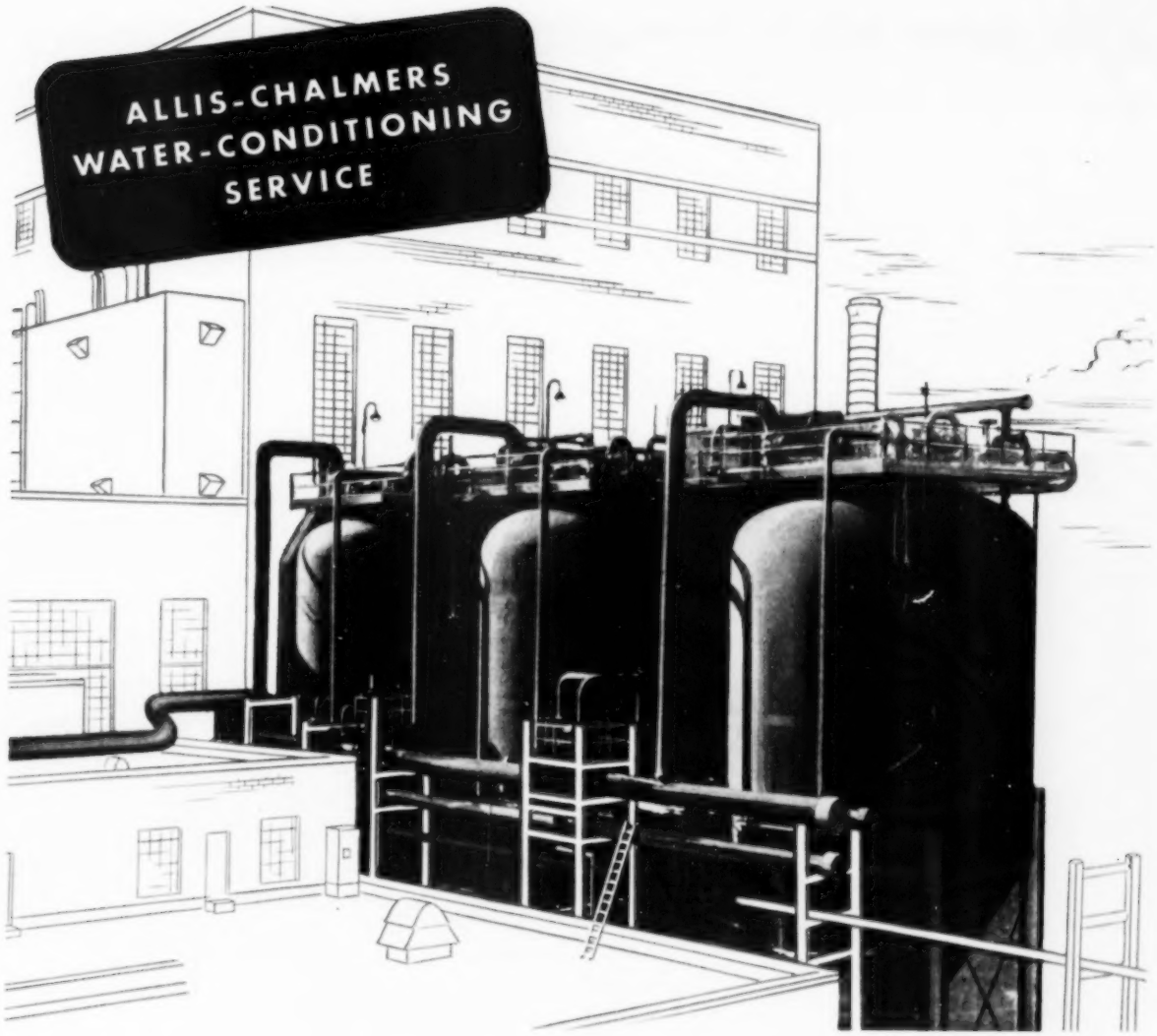


WATER HARDNESS CUT TO ZERO

at record rate of 240,000 gallons per hour!

THIS king-size, outdoor water-softening system was recently installed by Allis-Chalmers to meet the special needs of a leading midwest oil refinery. It furnishes four high-pressure boilers with filtered treated water at the extraordinary rate of 240,000 gallons per hour — the largest water-softening system ever installed in a refinery power plant.

Extremely rugged and designed for year-round operation outdoors, this Allis-Chalmers system has been in service about four years. There have been no breakdowns, and maintenance costs have been practically nil.

Whatever *your* industry—paper, petroleum, food, steel—you'll get prompt, convincing results with Allis-Chalmers Water Conditioning service.

For over 50 years Allis-Chalmers has been building power generation equipment. This experience is invaluable in providing our water conditioning specialists with the extensive background needed today to recommend correct equipment, chemicals and service.

An expert representative is available, ready to recommend proper chemicals or help select the right process for your power plant requirements. For complete information, contact your nearby Allis-Chalmers District Office, or write Allis-Chalmers, Milwaukee 1, Wis.

A-3916

ALLIS-CHALMERS

GENERAL MACHINERY DIVISION

MILWAUKEE, WIS. — PITTSBURGH, PA. — NORWOOD, OHIO — BOSTON, MASS. — TERRE HAUTE, IND. — MONTREAL, P. Q. — ST. THOMAS, ONT.

Are your high temperature tubes giving you the best life/cost ratio? *Ask the experts!*

This month's report is on: **DM STEEL**

Has unusually high creep strength for a pearlitic steel, good stability up to 1200° F., fairly good corrosion and oxidation resistance. Has 2 to 3 times the life of carbon steel where corrosion is not severe. Recommended for cracking furnace tubes, hot oil lines, superheater tubes, high temperature steam piping and forgings for accessory parts.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

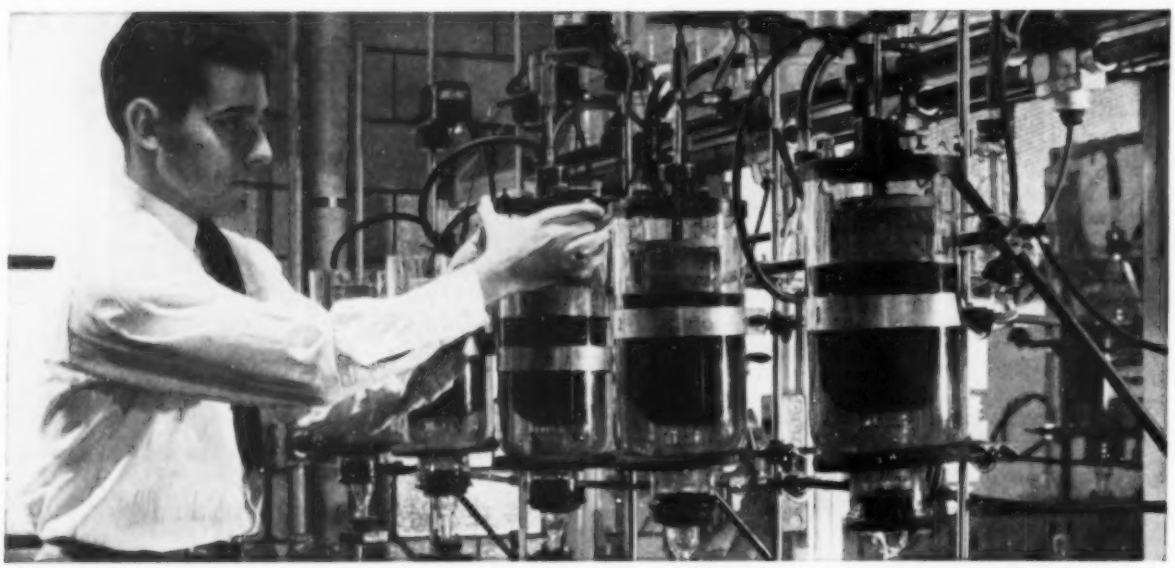
Carbon	Sicromo 2	Sicromo 5S	18-8 Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

**Available as seamless tubing on an experimental basis only.*
***Not available as seamless tubing.*

CHANCES are there are several high temperature tube steels that will solve your particular combination of heat, pressure, oxidation and corrosion problems. But there's only *one* analysis that will give you the best life/cost ratio.

The best way to find that one steel is to *ask the experts*—metallurgists of The Timken Roller Bearing Company. They're recognized authorities on high temperature steels, backed by 20 years' experience. With 24 different analyses to choose from, they'll help you pick the steel that's best suited for your particular application. And you'll be assured of uniform quality in every tube because the Timken Company rigidly controls the quality of the steel from melt shop through final inspection.

Let the Timken Company's RSQ—Research, Supply, Quality—solve your tube problems. *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".



Electrolytic equipment used in Timken Company laboratories to extract non-metallic inclusions from steels in research on steel cleanliness.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

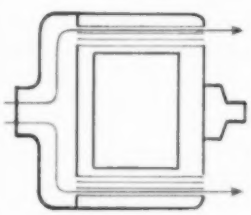
SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

Your *Best* Motor Buy

for Explosion Danger Areas

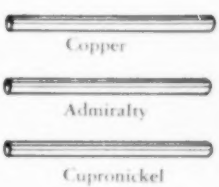
Here's Why

Practically Self-Cleaning



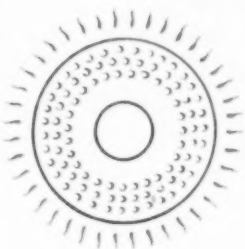
Air-to-air heat exchanger has straight, smooth tubes with no pockets to collect dirt or moisture. Velocity of cooling air through tubes keeps surfaces swept clean. If sticky dirt piles up, tubes can be cleaned quickly with long handled brush.

Choice of Tube Materials



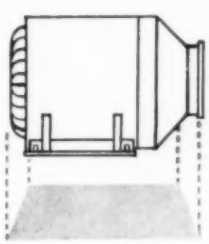
Allis-Chalmers tube-type motors can be built for service in corrosive atmospheres. Tubes may be made of a variety of materials. Motors will carry Underwriters' Label for Class I Group D or Class II Group F or Class II Group G.

Uniform Cooling



Tubes for carrying cooling air are distributed uniformly around the perimeter of the stator and along its full length. Result: heat travels over a short path and the interior is uniformly cooled.

Compact



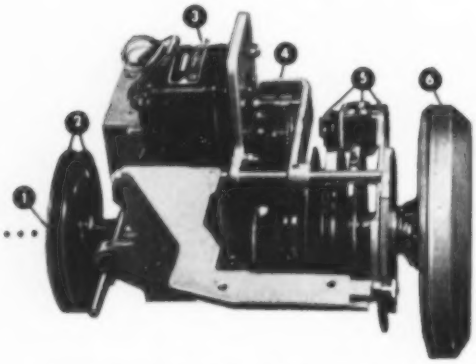
Allis-Chalmers tube-type motors are little or no larger than open motors of the same rating. Internal compartmentation divides motor into two chambers, keeping pressure at a lower level should an internal explosion occur.

Get Complete Information Now — Ask your Allis-Chalmers district office representative about tube-type explosion-proof motors in sizes up to 3000 hp with Underwriters' Labels to 800 hp at 3600 rpm. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, and ask for Bulletin 51B7149.

A-3964

ALLIS-CHALMERS

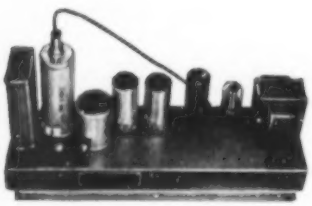
1. Center line of slidewire and shaft
2. Control cams
3. Balancing motor
4. Spring-loaded no-backlash drive
5. Control slidewires
6. Measuring slidewire



POWER IS PERFORMANCE

... and Speedomax Instruments lead with "huge" 12-watt balancing motors!

This partially dis-assembled view of Speedomax shows its two-phase Balancing Motor and gears, with a typically "heavy" load of slidewires and contacting cams for signal and control devices. Several more cams, etc., can be added if necessary; only practical limit is physical space on shaft. Smoothness in operating many contacts is an outstanding Speedomax ability.



Amplifier which feeds the Speedomax balancing motor the controlling half of its power. Torque gradient is especially high where needed most—around balance point—for prompt, positive balancing. This Amplifier leads its field by large margins in sensitivity and in power output.

Good circuit engineering shows in this Slidewire's non-inductive wiring and in the absence of any flexible leads which might form inductive loops.

• Power underlies good performance, in instruments as in automobiles, machine tools or rolling mills. That's why L&N engineers insist that an automatic instrument should operate as positively and promptly as any other high-grade machine.

Even the first null balance potentiometer Recorder we built, back in 1911, which went to a steel mill, had a 110-volt motor instead of a spring drive to run its balancing mechanism, chart and signalling contacts. And, while its pioneering of balance-method measurement attracted the most attention, its ample power certainly helped establish L&N Recorders as the coming idea in process Instrumentation.

Power has done the same for Speedomax instruments. Twenty years ago, Speedomax pioneered the electronic idea of measurement—in a husky, powerful piece of equipment. Today's models have from 2 to 4 times more power in their balancing motors than any other current models of electronic controllers, recorders or indicators.

This power means superior performance in both load-carrying and speed. Load-carrying ability applies especially when the motor operates, in addition, an unusual number of contact devices. But even the most usual Speedomax jobs—automatic control, for instance—can call on the instrument's power for high operating speed in handling the normal number of control devices. The strong, wide-faced, rigidly-mounted cams and gears so typical of Speedomax instruments start moving instantly, move rapidly and stop dead still without coast. Signalling and control action is correspondingly crisp and precise.

Speedomax for industrial use is described in Catalog ND46 (1); additional information for unusual applications is given in Technical Publication ND46(1). Either will be sent on request by our nearest office or from 4923 Stenton Ave., Philadelphia 44, Pa.

LEEDS NORTHRUP

instruments automatic controls • furnaces

CAREER OPPORTUNITIES AT L&N

Expansion program of this long-established firm has many features to attract outstanding recent graduates in engineering and science. Opportunities are in sales field engineering, product and application engineering, research, advertising, market development. Widely-respected policies assure recognition of progress and achievement. Address Personnel Manager for preliminary interview at nearest of 17 L&N offices.

Jtl. Ad. ND46(8)

People *will talk*

閣密克幫我們發展工業。
"Chemico helped us develop our industry"

"Chemico" heeft ons meer gegeven dan wij verwachtten.
"Chemico gave us more than we expected"

"كيميكو" رتبه
"It's designed by Chemico"

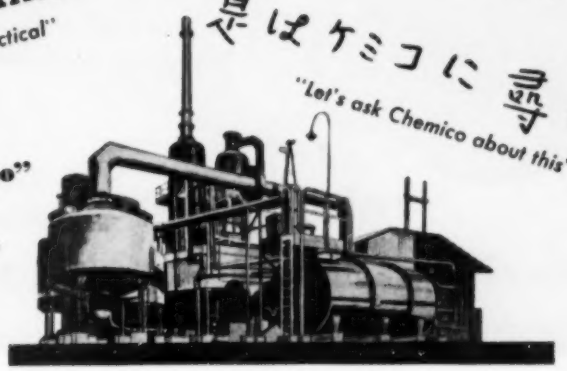
"केमिको" ने सारा काम किया।
"Chemico did the whole job"

"Chemico" comprend nos problèmes.
"Chemico understands our problems"

"CHEMICO" SABE SE É PRÁTICO.
"Chemico knows whether it's practical"

ケミコに尋ねよう!
"Let's ask Chemico about this"

La reputación de "Chemico" nos ha persuadido.
"Chemico's reputation sold us"



When our representatives travel to the far corners of the earth, they find that word of Chemico's activities has gone before them.

Yes, people *will* talk . . . and carry the news of Chemico accomplishments in the design and construction of plants for the production of heavy chemicals: fertilizers for India, Mexico, the Philippine Islands and Egypt; sulfuric acid for Canada, England, Formosa and Brazil; urea for Japan; sulfur recovery for Colombia; pickle liquor recovery for the Union of South Africa, to name a few. And naturally these are in addition to numerous large-scale projects in the United States.

Chemico has created, designed and erected more than 800 installations during the past 37 years that have given people much to talk about. That's why "Discuss it with Chemico" has become a byword of those who need new facilities or additional plant capacity to meet the world's ever-expanding heavy chemical needs.

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relax, man . . . . .

FLORI has the *whole* job!

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all of the proven FLORI means to a dependable, trouble-free job. Fabrication skill and modern equipment, together with FLORI men prominent in the piping erection field, will quickly dispense with "too many cooks" on your next job!

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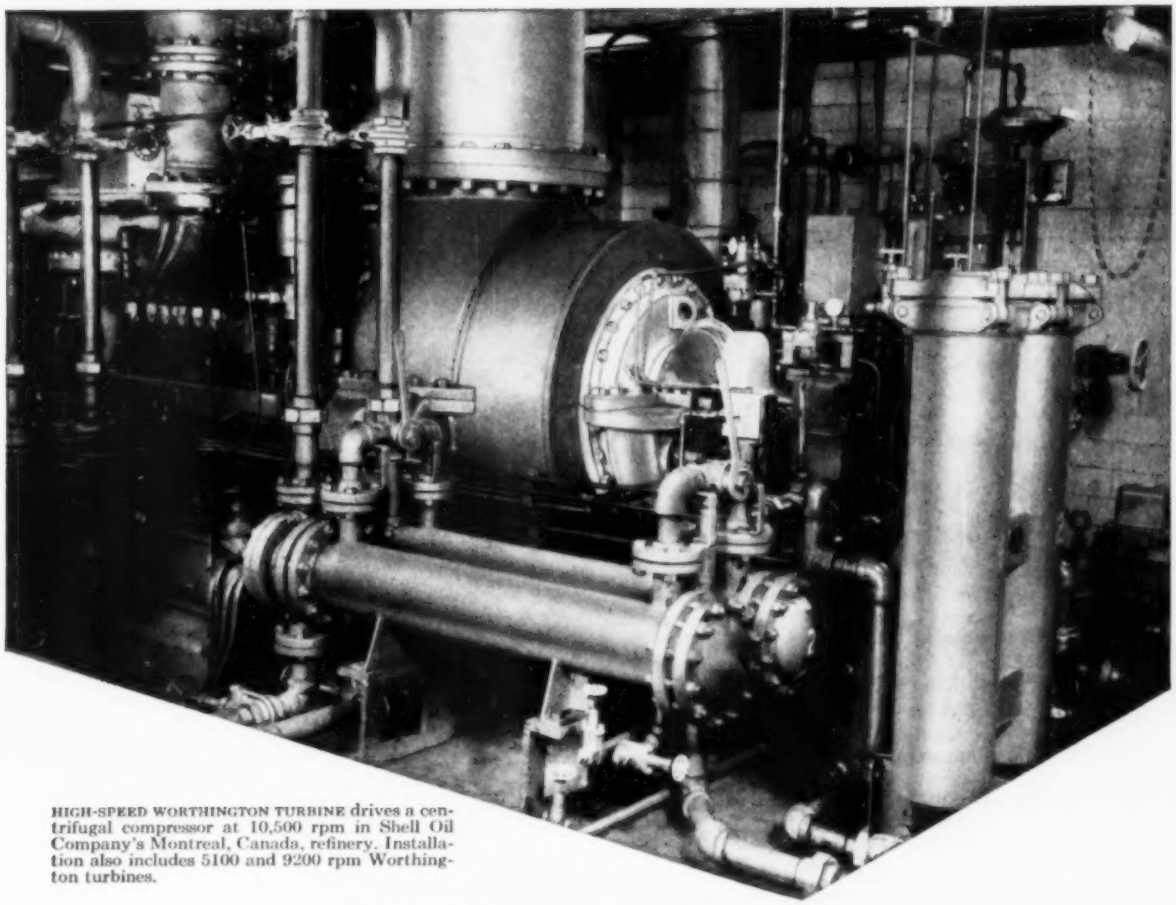


HIGH-SPEED WORTHINGTON TURBINE drives a centrifugal compressor at 10,500 rpm in Shell Oil Company's Montreal, Canada, refinery. Installation also includes 5100 and 9200 rpm Worthington turbines.

10,500-rpm turbine is third Worthington Compressor Drive Turbine installed at Shell Oil's Montreal refinery

It was in 1950 that Shell Oil built its new big catalytic cracking unit in Montreal.

And it was three high-speed Worthington steam turbines they chose to drive the very vital blowers and compressors. The 10,500-rpm turbine, like the other two, is so free of vibration that after two years of operation its speed can barely be detected on a vibrating-reed tachometer.

Cat-cracker service requires continuous 24-hour-a-day operation so that reliability is of prime importance. Such operation is typical with Worthington centrifugal compressor and blower drive turbines. But it's not the only reason they're preferred in hundreds of plants outside as well as inside the U. S. A.

With a high-speed Worthington steam turbine you can forget costly speed-increasing gears. You easily set the exact speed needed with various types of control and governing arrangements designed specifically for your requirements. Steam consumption is at a minimum, maintenance requirements are simple.

Write for Bulletin 1966 entitled "High Speed Turbines for Your Centrifugal Compressor and Blower Drives." T.2.10

SINGLE-STAGE TURBINES | MULTI-STAGE TURBINES | TURBINE-GENERATOR SETS | FEED WATER HEATERS | BOILER FEED PUMPS | SURFACE CONDENSERS

A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbines

for compressors at Sindri... at Suez... everywhere...

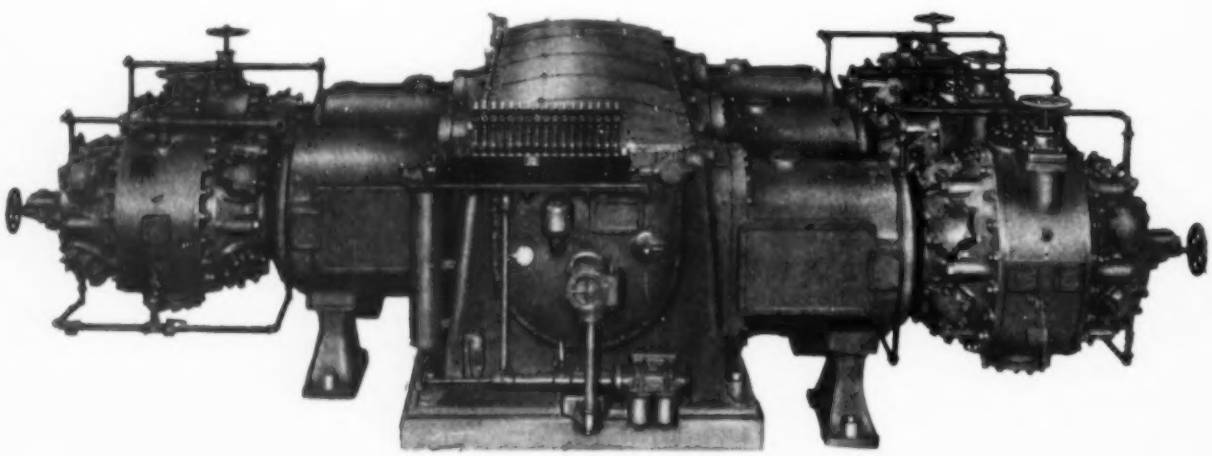
MODERN *Cooper-Bessemer* DESIGN HELPS MAINTAIN HIGH PRODUCTION . . . LOW COST OPERATION

•Shown opposite are Cooper-Bessemer motor-driven compressors in two of the world's newest and largest synthetic ammonia plants.

The top view shows part of the 22,000 Cooper-Bessemer M-Line compressor horsepower installed in the ammonia synthesis plant of the Sindri Fertilizer Factory, Bihar Province, India. Here, ammonium sulphate can be produced at a rate of 1,000 tons a day — 350,000 tons a year!

Similarly the other photo shows a line-up of Cooper-Bessemer compressors in the large Suez plant of the Societe Egyptienne D'Engrais et D'Industries (S.A.E.), Egypt. Here, calcium nitrate fertilizer is produced at a rate of 200,000 tons yearly.

In both plants, these modern Cooper-Bessemer units handle the entire compressing job and comprise the heart of production operations. For, with Cooper-Bessemers, you can be sure of year-in, year-out performance at the lowest operating cost.



COMPRESSORS-GAS ENGINES-DIESELS

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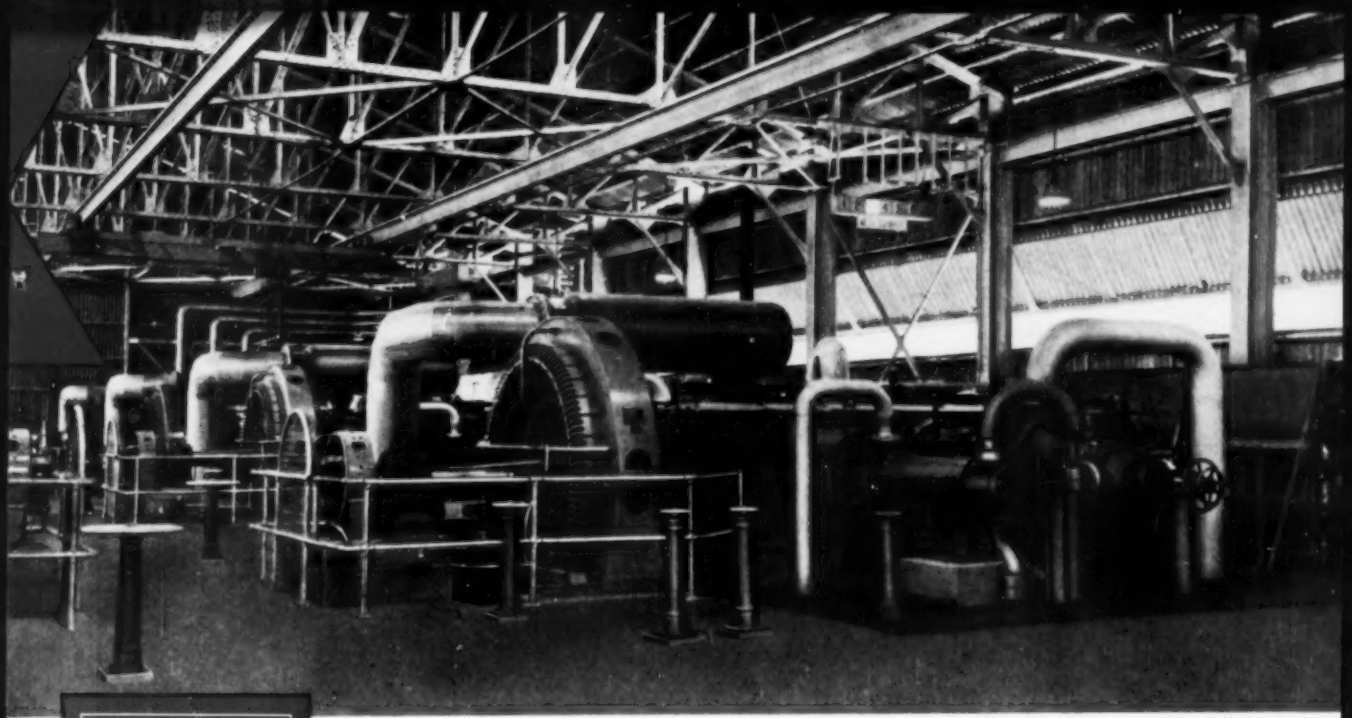
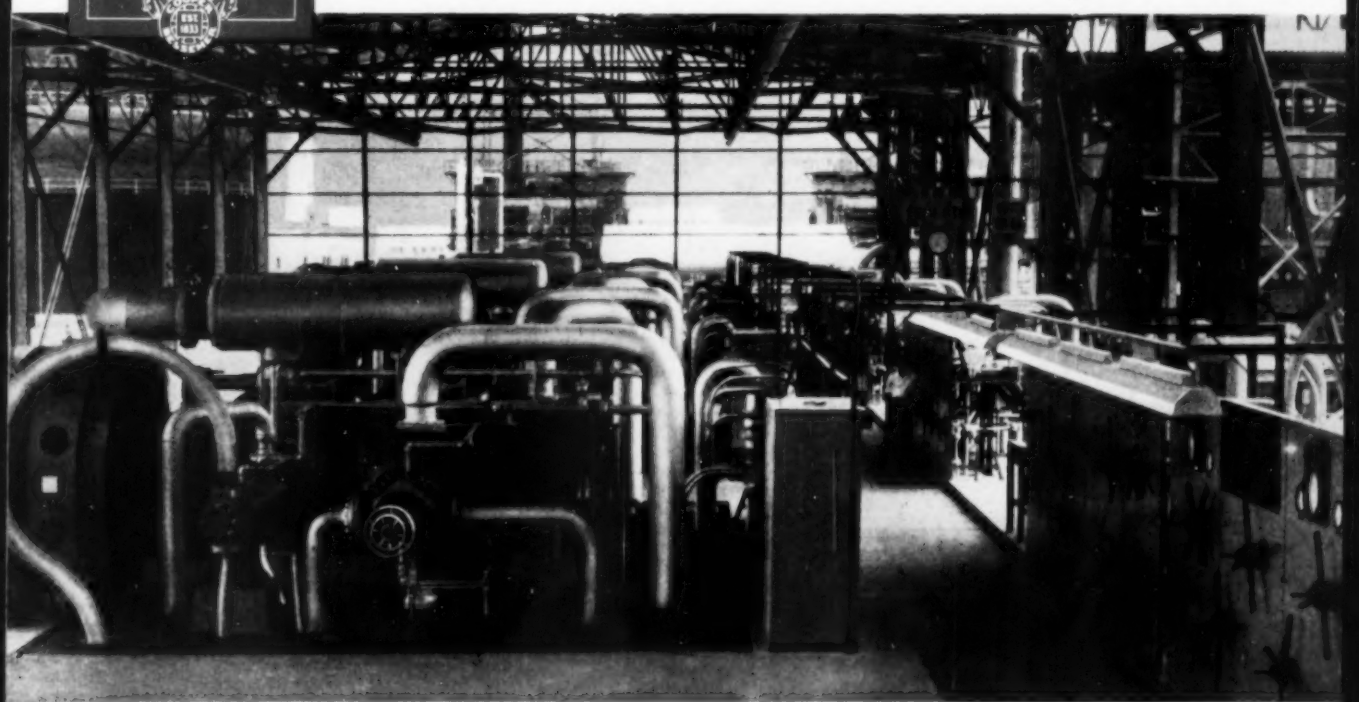


Another Example of Efficient Power at Lower Cost

Cooper-Bessemer M-Line motor-driven compressor in the synthesis section of the Sindri Fertilizer Factory, India. Here eight 2,750 hp 7-cylinder units compress gas through six stages to a pressure of 5,500 psi. The huge Sindri plant was engineered by the Chemical Construction Corp., New York, and built under the direction and supervision of the Power-Gas Corp., Ltd., England.

Here, in the Suez plant of the Societe Egyptienne D'Engrais et D'Industries (S.A.E.), these four 2,750 hp JM-5 motor-driven units compress 25,344 mcf of gas daily from atmospheric to 5,200 psi for initial calcium nitrate production of 200,000 tons yearly. This plant, engineered by the Chemical Construction Corp., utilizes waste gases from nearby oil refineries.

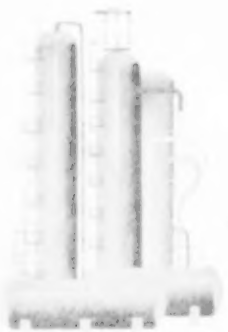


by **Cooper-Bessemer**

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela

ADVANTAGES NOT RESTRICTED BY SIZE



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HEATERS

For the smallest or the largest refinery unit Selas Gradiation Heaters incorporate the same desirable features:

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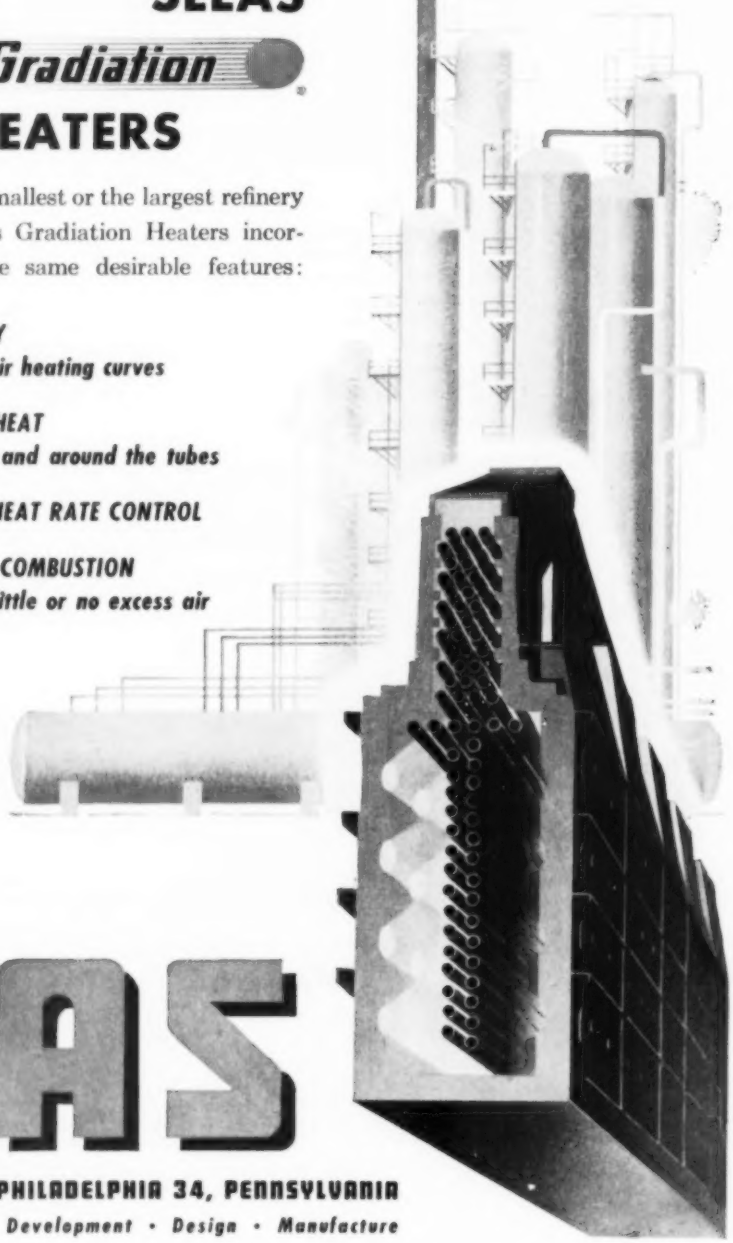
in their heating curves

UNIFORM HEAT
along and around the tubes

POSITIVE HEAT RATE CONTROL

COMPLETE COMBUSTION
with little or no excess air



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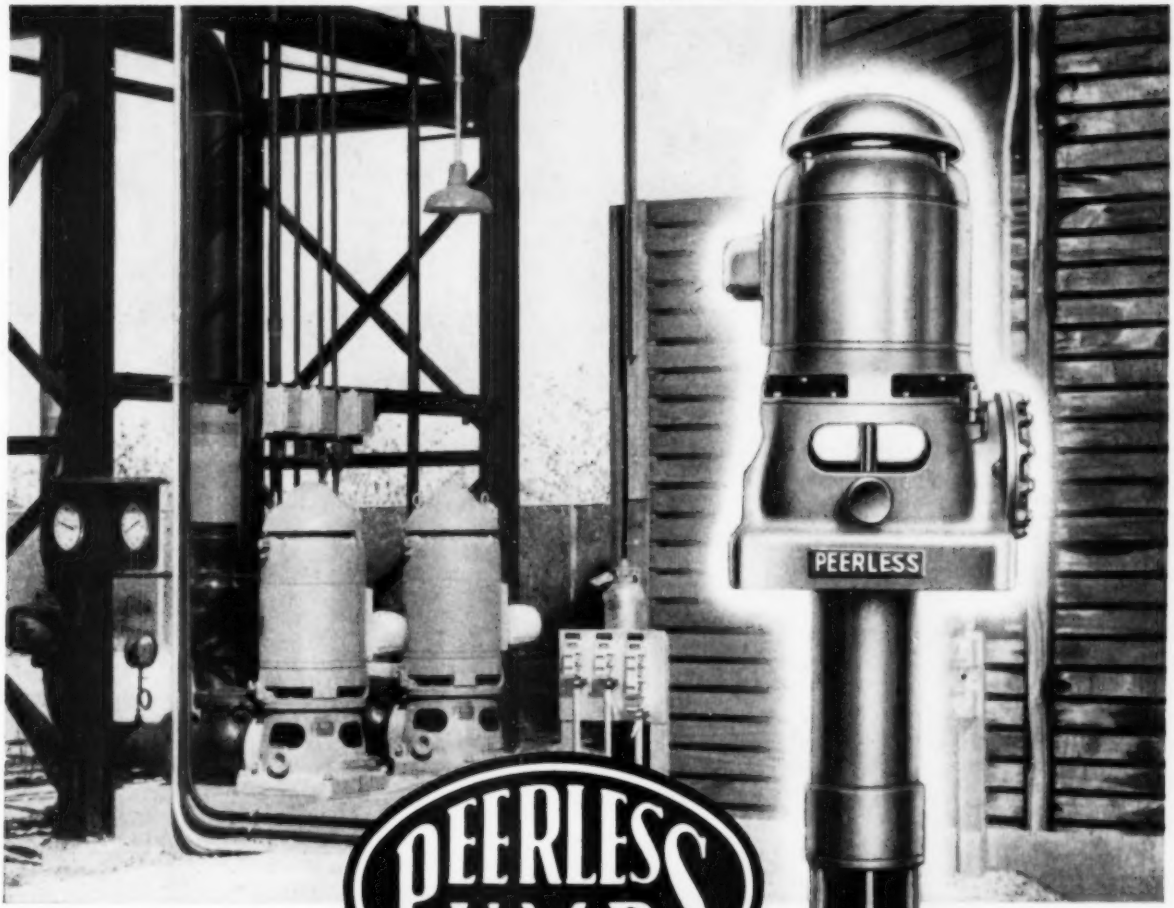
Heat Processing Engineers for Industry • Development • Design • Manufacture

PEERLESS CLOSE-COUPLED PUMPS



PEERLESS PUMPS

Here's why

YOU CAN PROFITABLY APPLY *Peerless* VERTICAL PUMPS TO COOLING TOWERS

1 *YOU ELIMINATE SUCTION PIPING* **2** *YOU ELIMINATE PRIMING PROBLEMS* **3** *YOU SAVE INSTALLATION SPACE*

Not only is the Peerless vertical design a definite space saver over other pump types but it eliminates much of your piping and fitting costs and once primed, this vertical turbine pump is always primed; fear of running the pump dry is no hazard here. A vertical close-coupled pump is also best suited to adaptation to future system demands. Furthermore, it's the easiest of all pumps to service, maintain and adapt. NPSH required for operation may be adjusted to available NPSH in most installations because of the flexibility of this vertical design. A minimum of submergence is required for operation. Peerless field engineering service on vertical cooling tower pump designs is nation wide. Consult with the Peerless sales office or distributor nearest you. They can be of help in cooling tower sump design as well as pump and driver selection to obtain the most efficient and trouble-free cooling tower pumps. Or mail the coupon today for full information.

Capacity: 30 to 30,000 GPM

Head: Widest head range—from minimum to 1000 feet

Impeller: Special hydraulic design for low NPSH

Drives: Standard and explosion proof vertical pump motors. Also vertical and horizontal (right angle) steam turbine and right angle stationary engine drives.

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Please send complete data on vertical close-coupled pumps for cooling tower service.

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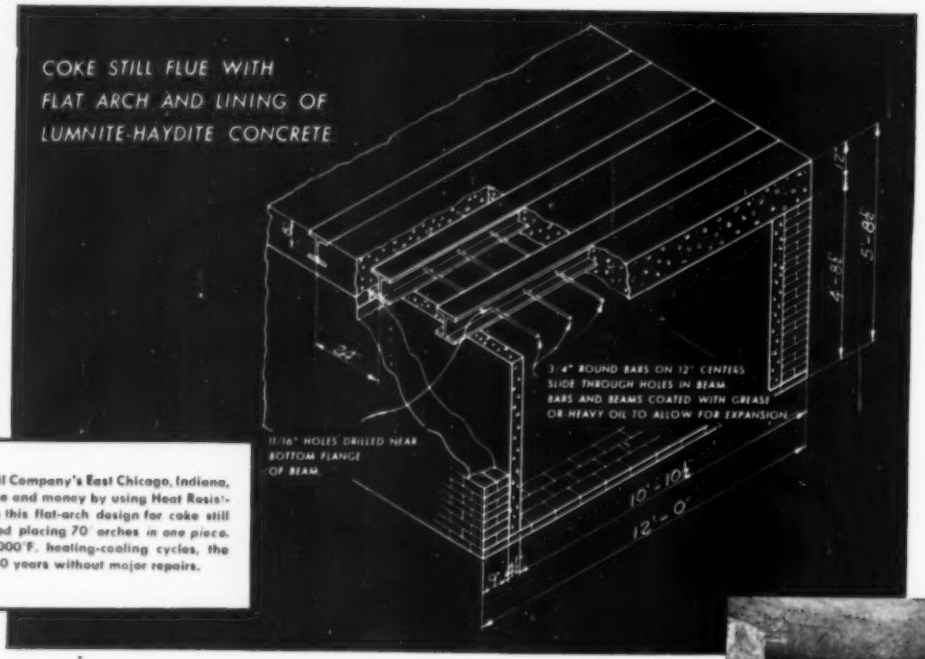
PR

Special Industrial Concrete Cuts Refinery Costs



Cities Service Oil Company's East Chicago, Indiana, plant saved time and money by using Heat Resistant Concrete in this flat-arch design for coke still flue. It permitted placing 70' arches *in one piece*. And despite 1000°F. heating-cooling cycles, the arches served 10 years without major repairs.

. . . resists high temperatures . . . corrosion . . . thermal shock

In more and more refinery installations, such as the one shown here at Cities Service, East Chicago, Indiana, plant, costs are being trimmed and efficiency boosted by using industrial concrete where heat and corrosion exist.

In addition to the usual convenience and structural advantages of concrete, special concretes made with Lumnite* calcium-aluminate cement provide:

HEAT RESISTANCE—*up to 2600°F.*

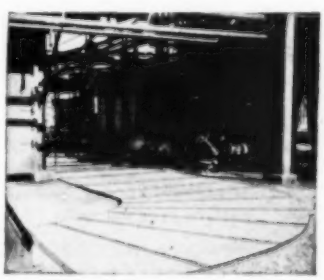
CORROSION RESISTANCE—*with suitable aggregates*

INSULATION—*with insulating aggregate*

Lumnite concrete can be easily placed by plant labor, if maintenance repairs are needed, and is strong enough for service within 24 hours.

Castables for convenience —Make Refractory Concrete with prepared castable mixes of Lumnite cement and aggregate selected for specific temperature and *insulation* requirements—only water is added. They're made by refractory manufacturers and sold through their dealers. For more information, write Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Ave., New York 17, N. Y.

TAKES HEAT IN STRIDE—Coke still gases enter the Heat Resistant Concrete flue at a temperature of approximately 1000°F. As you can see, it's still in good condition after a decade of service.



MAKES CURVES EASY—Although the flat arch of this flue curves alongside the coke still, construction was simple with poured-in-place Lumnite Concrete. This plant also uses it for linings in header castings, heaters, stacks, fire doors, vessels of all types and rush concrete work.

**"LUMNITE" is the registered trade-mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

PR-L-77

ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

international engineering "know how"

Building a refinery or chemical plant in a foreign country involves many considerations in addition to the basic functions of design and construction.

Foster Wheeler's worldwide experience gained from building more than 250 process units in over 40 foreign countries is saving its clients both time and money.

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process units
complete refineries
complete chemical plants

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Construction continues at England's largest refinery.

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A recent completion at Edmonton.

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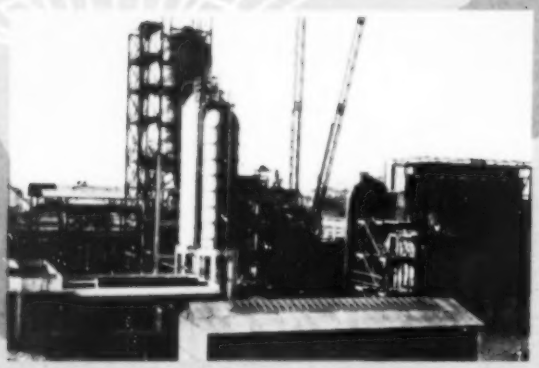
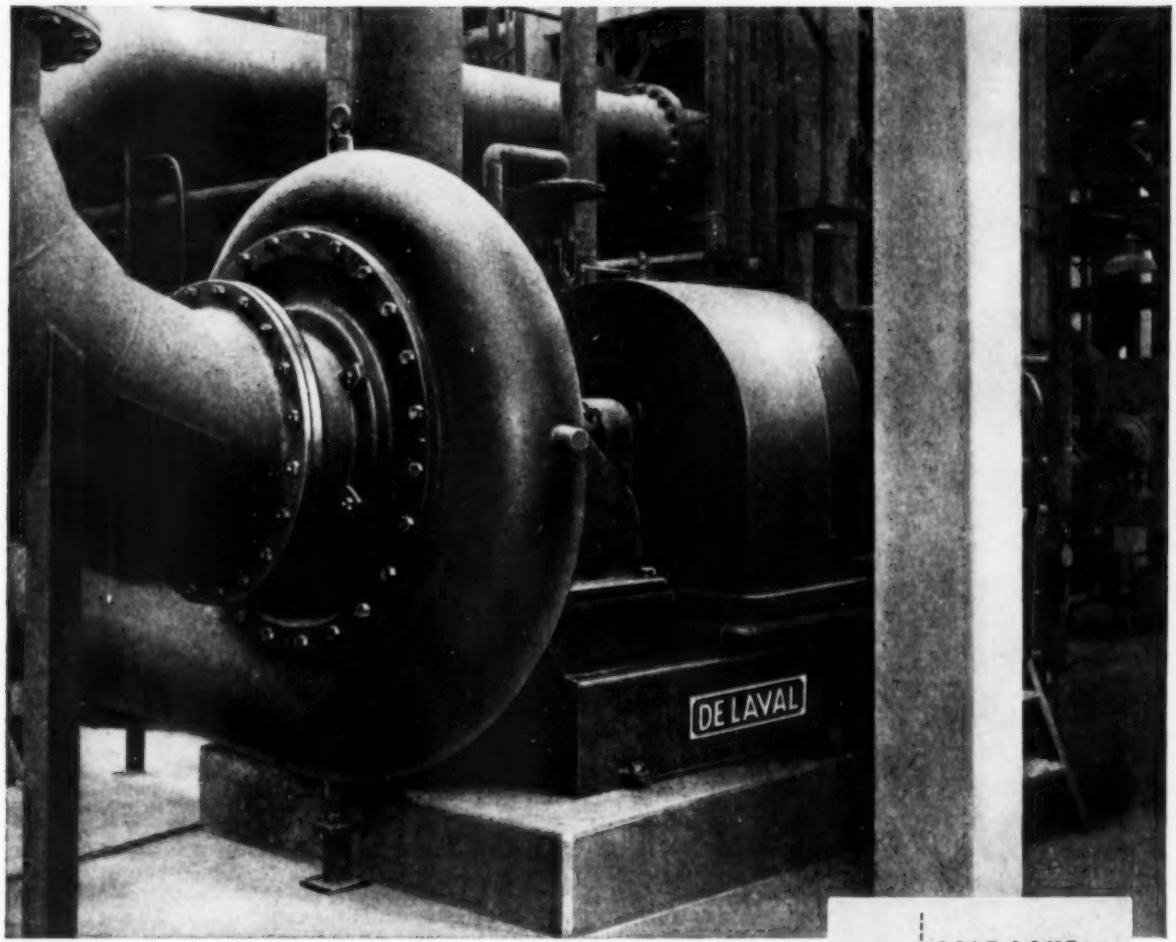


Catalytic cracking and other units under construction in France.

FOSTER WHEELER

Complete engineering facilities at New York, Paris, London, St. Catharines, Ontario and Houston, Tex.



This blower never takes a "breather"

at SALT LAKE REFINING COMPANY

"It's on the line for good!" That's the kind of dependability this De Laval cat cracker blower delivers. The single stage, 26,000 cfm blower is driven by a De Laval 700 hp, four stage turbine. We build both units—there's no divided responsibility.

Economical De Laval blower performance is the result of quality design and manufacture every step of the way. A rugged casing and husky precision balanced rotor guarantee long life in heavy-duty service. The pressure lubricated sleeve bearings and Kingsbury type thrust bearing insure long periods of continuous operation with a minimum of maintenance.

De Laval blower experience covers a wide range of industries: refining, metal mining, steel, chemical processing, high pressure gas transmission, manufactured gas, sewage aeration and many others. All this engineering and manufacturing experience is ready to solve your specific blower application.

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DE LAVAL *Centrifugal Blowers*

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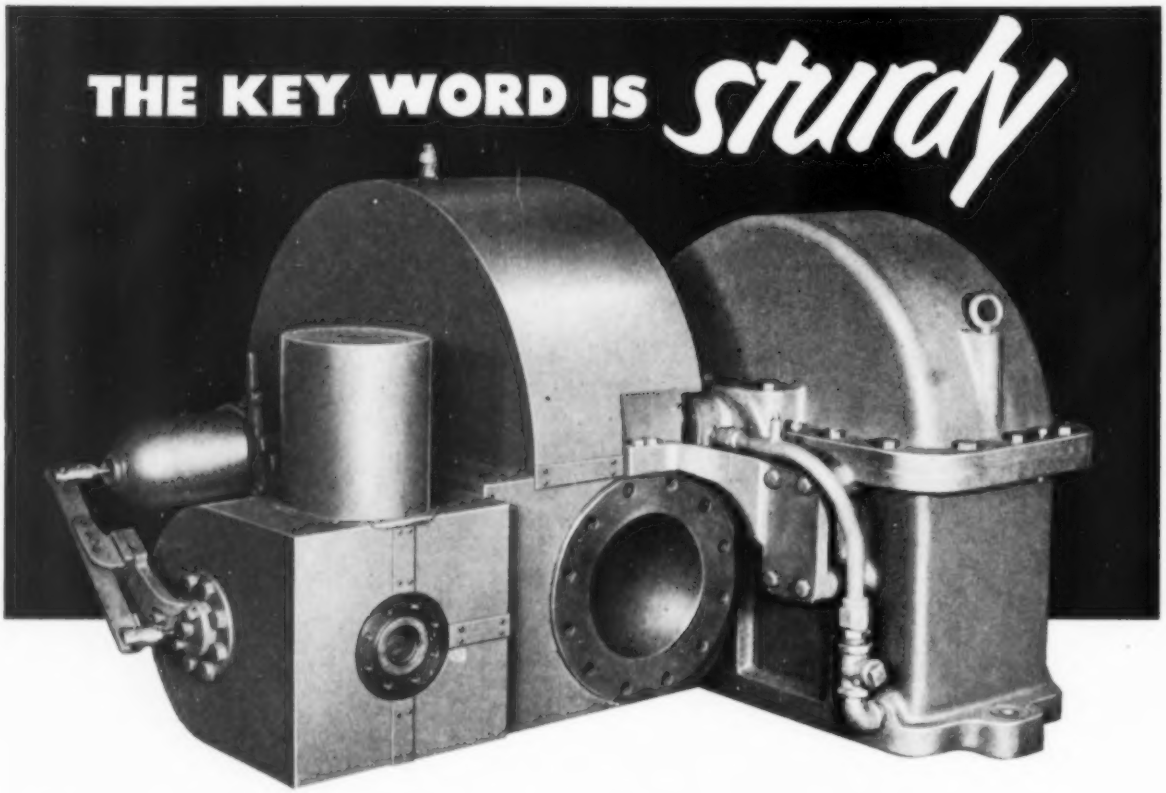
THE KEY WORD IS *sturdy*



THE *new* ELLIOTT GEARED TURBINE

The new JR turbine

At the turbine end, the ever-dependable and popular Elliott YR Turbine, which has demonstrated its remarkable staying powers beyond all question in every industry utilizing auxiliary steam drive units. The versatility of this machine, with its wide selection in governors and controls, is only matched by its strength and "keep-going" endurance.

At the gear end, the equally tough gear assembly with gear and pinion of double-helical type to provide quiet power flow without thrust. Pinion and turbine wheels are both mounted on the same shaft. Jig-drilled bolting in gear-case and turbine insure positive alignment and a rigid unit. Bearings have forced-feed lubrication, and the gear has oil sprays at the meshing point to insure lubrication and cooling.

Also available in "coupled" type, with individual turbine and high-speed gear shafts flexibly coupled.

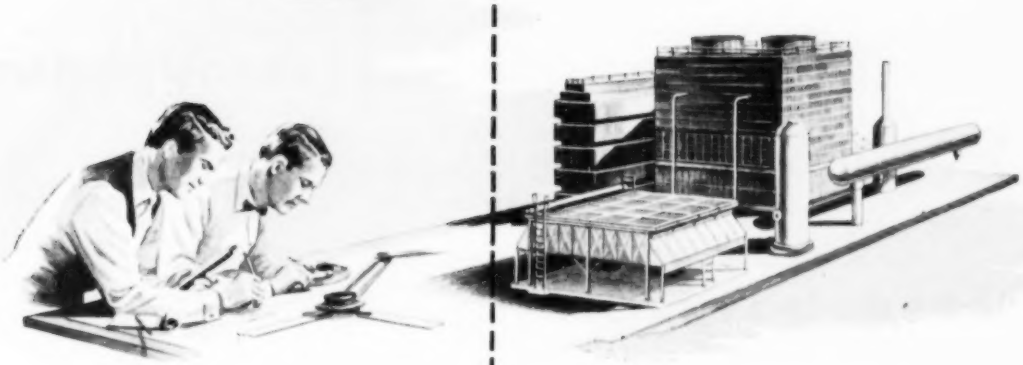
For details contact your local Elliott representative, or write Elliott Company, Jeannette, Pa. for bulletin.

ELLIOTT Company

STEAM TURBINE DEPARTMENT

H3-2

BE SURE WITH *Fluor*



IN ENGINEERING AND CONSTRUCTION

Fluor's Engineering and Construction Division is a complete organization for the development of process methods, mechanical design, equipment procurement, field erection and initial operation of plants and facilities for the oil, gas-gasoline, chemical, power and allied industries.

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Fluor's manufactured products include Aerator and Counterflo Cooling Towers, Fin-Fan Air-Cooled Heat Exchangers, Pulsation Dampeners, Mufflers, Gas Cleaners and related equipment. Second to none in quality or performance, Fluor products are in service in petroleum, chemical and power installations throughout the world.

You are invited to write for complete information on any or all phases of Fluor's operations.

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This complete ferrous sulfate recovery plant is tubed with ELECTRUNITE Pressure Tubes.

HEAVY CHEMICALS

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ELECTRUNITE PRESSURE TUBES

In this ferrous sulfate recovery plant, for example, evaporators, calandrias, dryers, and crystallizers are tubed with ELECTRUNITE Heat Exchanger Tubes. Throughout the chemical industries, ELECTRUNITE Pressure Tubes help keep dozens of processes on-stream longer between retubings. Production schedules are maintained; production costs are kept down.

ELECTRUNITE Pressure Tubes are uniform in ductility and corrosion resistance all-around and end-to-end. Full-normalizing assures clean scale-free surfaces.

Tell us what you process in your heat exchangers, condensers, and dryers. We'll gladly tell you which ELECTRUNITE Pressure Tubes, carbon or stainless, will do the best job for you.

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PENFLEX FLEXIBILITY
ALLOWS LINES TO WALK WITH TANK

Write for this helpful folder, "Flexineering" . . . your guide to flexible tubing

Heat . . . cold . . . tank settling . . . all made rigid pipe on oil storage tanks in a large New England bulk plant move, bend and break. Every break meant oil and gasoline lost . . . fire a constant threat.

Then Penflex "Flexineering" solved the problem. Pipe breakage has been eliminated with a length of 12" I.D. four-wall interlocked, specially packed Penflex tubing . . . installed with tight-packed flanges. Now any amount of thermal expansion or tank settling can occur with no leaks, breaks or spillage. Penflex tubing is tight as a pipe . . . yet flexible under all conditions.

Let Penflex engineers help solve your tubing problems. Penflex manufactures a complete line of four-wall interlocked and seamless welded corrugated flexible tubing . . . metallic hose, tubing or couplings from 1/8" I.D. and up . . . automatic barrel fillers, accessories and fittings.

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HEART OF INDUSTRY'S LIFE LINES

How CROSBY'S BALANCED AREA DESIGN eliminates back pressure effects

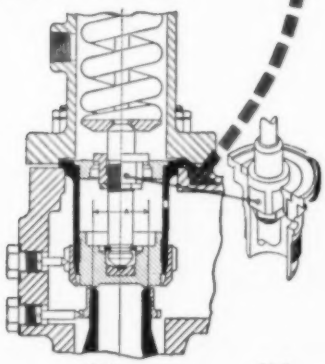


Fig. 1 Fig. 2

When a standard relief valve on gas or vapor service is installed, where back pressure exists, one of two undesirable effects will occur:

Constant Back Pressure — The back pressure acts on part of the upper and the overhanging part of the lower surface of the disc, cancelling out the back pressure force. There remains, however, a force acting on the top portion of disc (area A) which increases the spring load and causes the valve to pop "heavy."

Variable Back Pressure can not be compensated for by spring adjustments. When one or more valves discharge into a common flare header, variable back pressure is placed on the remaining closed valves. This can create a hazardous condition on remaining closed valves, by adding to the spring force. The valve then is prevented from opening until pressure has risen far above the vessel design limit.

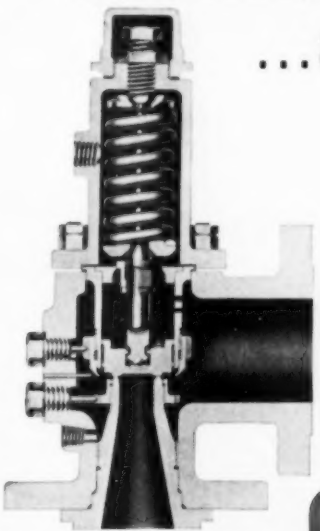
The Crosby Balanced Area Design is a simple, foolproof method of nullifying these undesirable effects (see Figure 1 above).

Operation — Crosby achieves *Stable Popping Pressure* by the addition of a piston affixed to the spindle, of area proportioned to equal the unbalanced area of the disc (area A in Fig. 1). Back pressure introduced through the port in the guide then acts on two equal areas in opposite directions, and cancels itself out, neither aiding nor opposing the spring.

To assure full lift and stability, a vent system (see sectional view of piston, Fig. 2) is employed. When the valve is open, the flats on the piston will vent any accumulated back pressure that would tend to close the valve. The adjustment and operating characteristics are similar to the conventional valve. The actual flow into the bonnet is relatively low and can be vented to atmosphere, or through a properly sized discharge header.

Extensive, trouble-free use in the field has proved the success of this Crosby Balanced Area Design.

Here's the CROSBY RELIEF VALVE which eliminates back pressure effects ...and reduces costs!



CROSBY RELIEF VALVE
Style JO-BP
with BALANCED AREA DESIGN
for the elimination
of Back Pressure Effects.

Proved ECONOMY!

On the many installations where Crosby JO-BP Valves have been in operation, refineries report sizable savings in piping costs. The reason—smaller discharge lines made possible by higher back pressure. Since Crosby JO-BP Relief Valves will handle back pressure surges ranging up to 90% of inlet pressure, smaller diameter discharge pipe carries the same amount over the same distance that formerly required much larger pipe.

Proved PROTECTION!

On-the-job performance of Crosby JO-BP Relief Valves proves that you can depend on the vented Balanced Area Design to operate on the set pressure. Thus you are assured of a *Stable Popping Point*. What's more, a full lift is obtained over the normal range of back pressures. The Crosby JO-BP operates with an unrestricted nozzle, follows standard nozzle flow equations for above or below critical ratio as the case may be. With its vented Balanced Area Design, the Crosby JO-BP provides a foolproof, time-tested method of eliminating back pressure effects.

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District Sales Offices:
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All SHELL AND TUBE ...HEAT EXCHANGERS by Vogt

ABOVE: View of new construction at Louisville Refining Company.

BELOW: Some of the many Shell and Tube Exchangers.

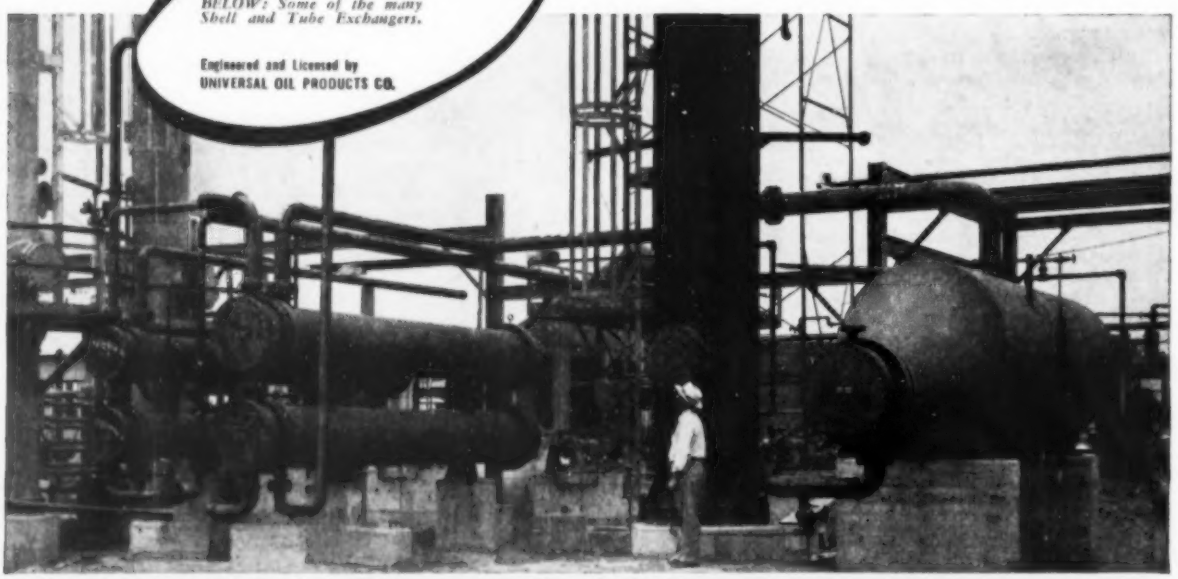
Engineered and Licensed by
UNIVERSAL OIL PRODUCTS CO.

At LOUISVILLE REFINING CO.'S New CATALYTIC CRACKING PLANT

Premium gasoline production has been boosted 20% from the same amount of oil charged since the Louisville Refining Company's new Catalytic Cracking Plant went on stream.

The new plant uses Vogt Shell and Tube Heat Exchangers exclusively and they make a significant contribution to the efficient and economic operations of this progressively modern refinery. Vogt Shell and Tube Heat Exchangers are available in many different types, with fixed or removable tube bundles, to meet the special problem and specific operating conditions of each installation. They are constructed from carbon and special steels to meet every temperature, pressure, or vacuum service requirement.

WRITE FOR BULLETIN HE-6



HENRY VOGT MACHINE CO. Louisville 10, Ky. • BRANCH OFFICES: NEW YORK, PHILADELPHIA, CHICAGO, CLEVELAND, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

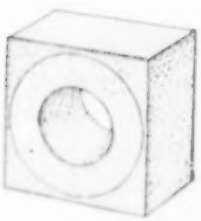
B&W KAOCAST goes in more furnaces because...

Versatile B&W Kaocast can be molded quickly and easily with your own labor. It can also be cast directly in place or applied with a cement gun. This unique 3000 degree refractory castable has high resistance to spalling and slag attack, low volume change and negligible reheat shrinkage. Consult a B&W Refractories Engineer on your specific applications and see how B&W Kaocast can save money for you.

It cuts inventory

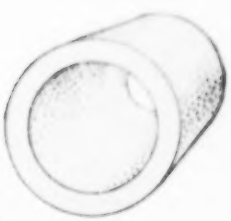
Nose arches for oil heaters were formerly made with special shapes of ordinary firebrick. Switching to quickly moldable Kaocast eliminated need for expensive special-shape inventory . . . minimized delays. In addition, side by side tests proved that Kaocast far outlasted the ordinary firebrick.

It speeds repairs



Kaocast was specified for the charging front of a forging furnace, used to heat heavy pipe ends. The reason? Kaocast linings were molded faster . . . give longer service, could be made when convenient and stored 'til needed.

It lasts longer



A chemical plant found that burner tile for a heating furnace made of an ordinary castable stood up only 3 to 4 months. But Kaocast burner tile stayed on the job 16 months and longer. Thousands of pounds of Kaocast have been used for this and many other applications in this plant.

BABCOCK & WILCOX

R455

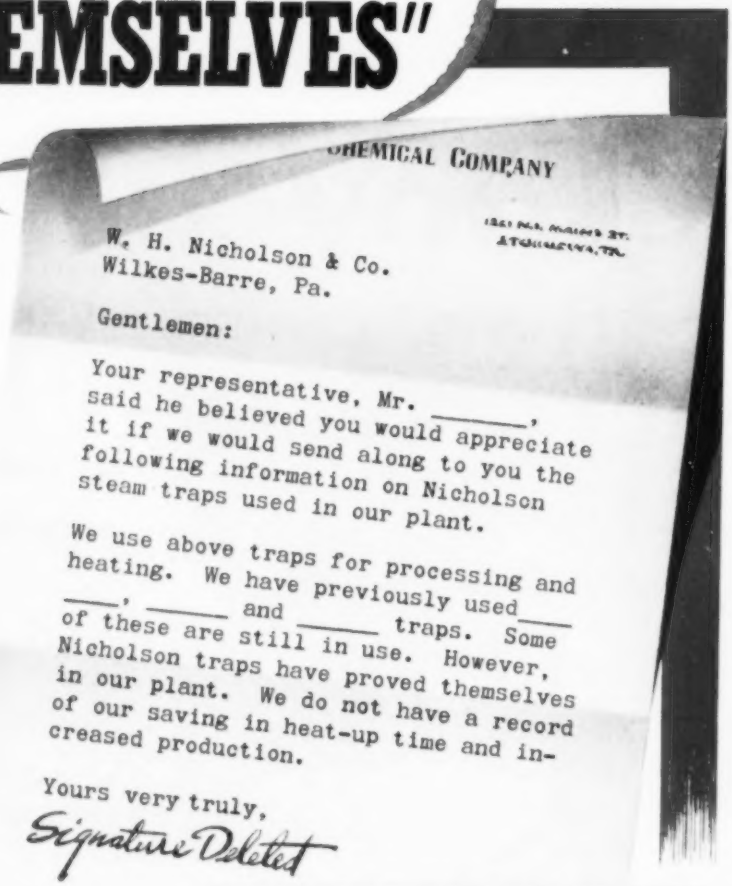
THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST. NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

B&W REFRACTORIES PRODUCTS—B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick B&W Refractory Castables, Plastics and Mortars • OTHER B&W PRODUCTS—Stationary & Marine Boilers and Component Equipment... Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers . . . Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

"NICHOLSON TRAPS PROVE THEMSELVES"

..in plant of one of Big 6 chemical firms

The importance of improving heat transfer efficiency in today's great processing plants increases as the proportion of critical applications grows and steam consumption mounts. The letter at the right is from one of the great chemical companies which have adopted Nicholson traps. Another of them recently reported that Nicholson traps were installed at one of their plants as part of a campaign to promote economical steam use. It resulted in a yearly saving of $500,000. See why an increasing number of leading plants are standardizing on Nicholsons.



...CHEMICAL COMPANY

...Main St.
...TN.

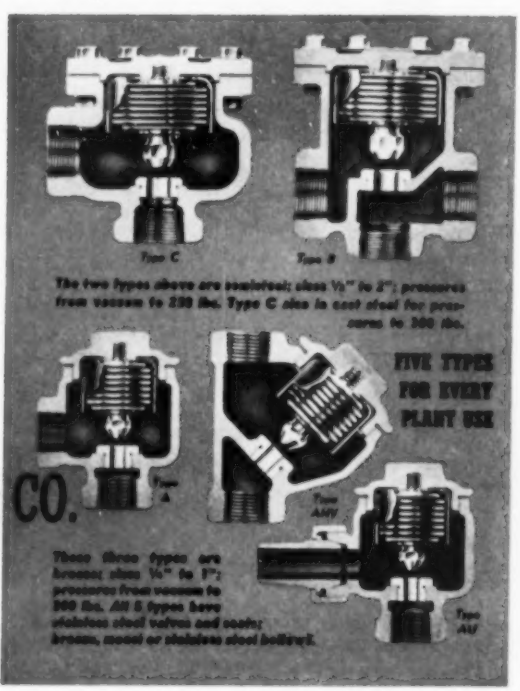
W. H. Nicholson & Co.
Wilkes-Barre, Pa.

Gentlemen:

Your representative, Mr. _____, said he believed you would appreciate it if we would send along to you the following information on Nicholson steam traps used in our plant.

We use above traps for processing and heating. We have previously used ____, _____ and _____ traps. Some of these are still in use. However, Nicholson traps have proved themselves in our plant. We do not have a record of our saving in heat-up time and increased production.

Yours very truly,
Signature Deleted

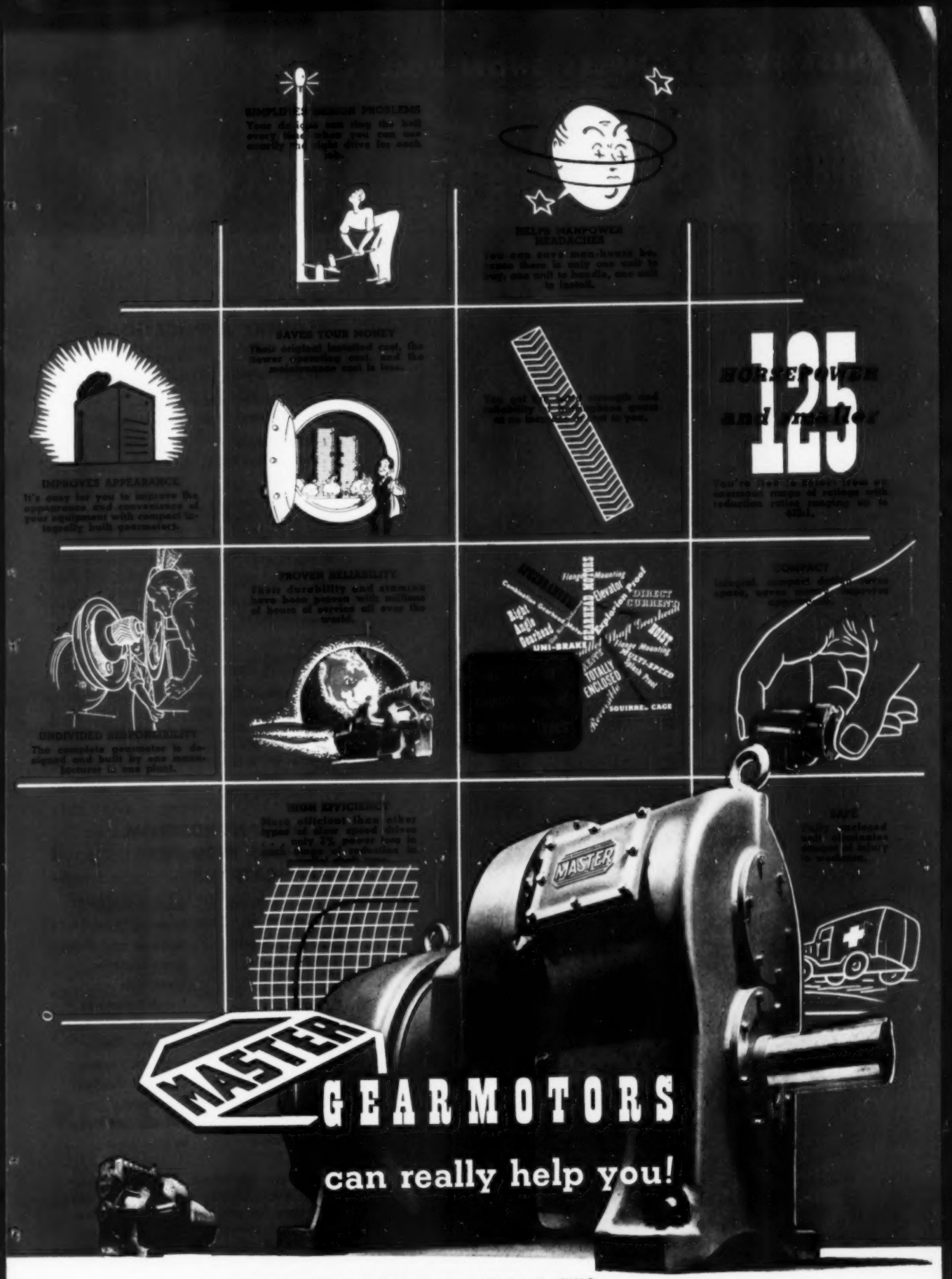

Type C
Type B
The two types above are semisteel; sizes ½" to 2"; pressures from vacuum to 250 lbs. Type C also in cast steel for pressures to 300 lbs.
FIVE TYPES FOR EVERY PLANT USE
Type A
Type AHV
Type AU
These three types are brasses; sizes ½" to 1"; pressures from vacuum to 300 lbs. All 3 types have stainless steel valves and seats; brass, monel or stainless steel bellows.

Send for TRAP CATALOG 751

This 32-page standard reference is complete with installation diagrams as well as charts and formulae for determining proper size of trap.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS
207 OREGON ST., WILKES-BARRE, PA.
Sales and Engineering Offices in 58 Principal Cities


SIMPLIFIES MACHINE PROBLEMS
HELPS MANPOWER HEADACHES
SAVES YOUR MONEY
IMPROVES APPEARANCE
It's easy for you to improve the appearance and convenience of your equipment with compact integrally built gearmotors.
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HORSEPOWER
and smaller
PROVEN RELIABILITY
Their durability and stamina have been proven with millions of hours of service all over the world.
UNDIVIDED RESPONSIBILITY
The complete gearmotor is designed and built by one manufacturer in one plant.
COMPACT
HIGH EFFICIENCY
SAVE
MASTER
GEARMOTORS
can really help you!

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO

THESE TWO EXAMPLES SHOW YOU

What Nordstrom Means by "Lubricaut

Nordstrom three-way Transflo valves on relief service at top of propylene tower separating propylene from propane.

TYPICAL NORDSTROM REFINERY APPLICATIONS

- Catalytic Polymerization
- Crude Topping and Vacuum Distillation
- Fluid Catalytic Cracking and Gas Recovery
- Distillate Recovery in Cycling Plants
- Duo-Sol Solvent Extraction
- Houdriflow Catalytic Cracking and Gas Recovery
- Light Ends Fractionating
- Thermal Cracking
- Phenol Extraction
- Propane Deasphalting
- Cycloversion
- Delayed Coking
- Girbotol Process
- Propane Dewaxing
- Hydroforming Process
- Naphtha Polyforming
- Solexol Process
- Solvent Dewaxing
- Thermal Reforming

Nordstrom has compiled a series of specification sheets for each of these processes, showing recommended materials, pressure classes, lubricants and valve figure numbers. Ask your Nordstrom sales engineer to review them with you.

TYPICAL NORDSTROM PROCESS INDUSTRY APPLICATIONS

- Beverage Plants
- Cement Plants
- Chemical Plants
- Explosives
- Food Plants
- Gas Plants
- Ice and Refrigeration
- Paint and Lacquer
- Paper and Pulp
- Pharmaceuticals
- Power and Steam Plants
- Rubber Plants
- Sewage Plants
- Smelters and Mines
- Soap Factories
- Steel Mills
- Sugar Refineries
- Synthetic Ammonic
- Synthetic Fibers
- Synthetic Plastics
- Synthetic Rubber
- Tanneries
- Textiles and Dyes
- Water Works

The new Nordstrom Corrosion-Resistant Valve Bulletin V-217 will make it easy for you to fit the right valve to each service. Write for a copy, Rockwell Manufacturing Company, Pittsburgh 8, Pa., or ask your Nordstrom sales engineer.

-Sealed for POSITIVE SHUT-OFF"

Here are two typical Nordstrom valve process applications—one is a propylene tower, the other a dry hydrogen line.

They illustrate an important point in specifying valves for process service . . . if really tight shut-off of hard-to-hold gases or fluids is important, no valve can do the job better than Nordstrom.

Why? Because Nordstrom is the original lubricated plug valve. Nordstrom is the valve with the extra seal of plastic lubricant around the valve ports to check seepage of even the lightest, most penetrating substances.

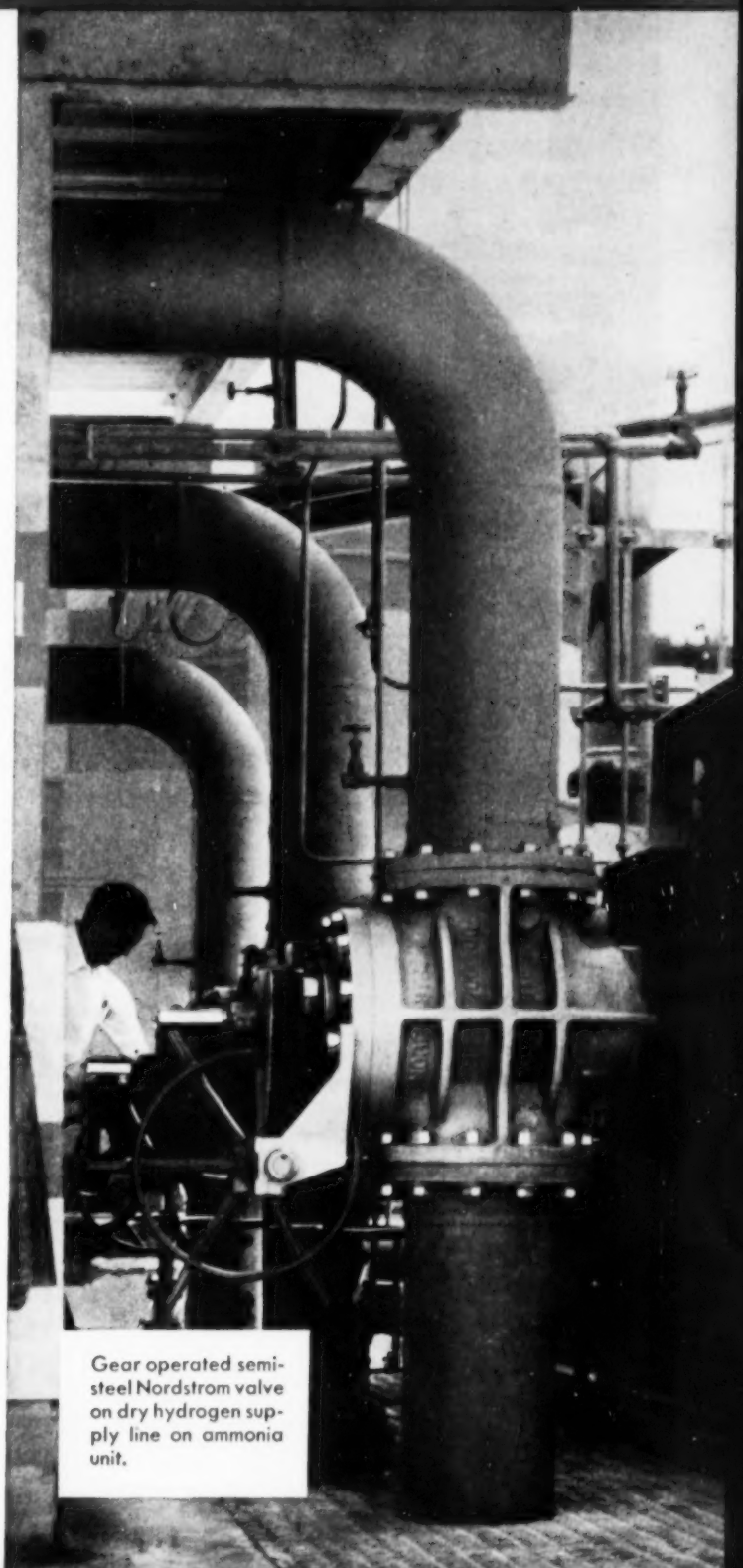
That, of course, means greater safety, and greater economy, too, because when leakage is prevented, valve life is far longer. And most important, it means uninterrupted operation of continuous process units—no down-time for avoidable valve repairs.

The same lubricant that seals, also keeps the valve ready to operate in an emergency.

Nordstrom valves are built in a wide range of sizes, pressures, special metals and body designs for the process industries, including three- and four-way designs for batching, blending and switching. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

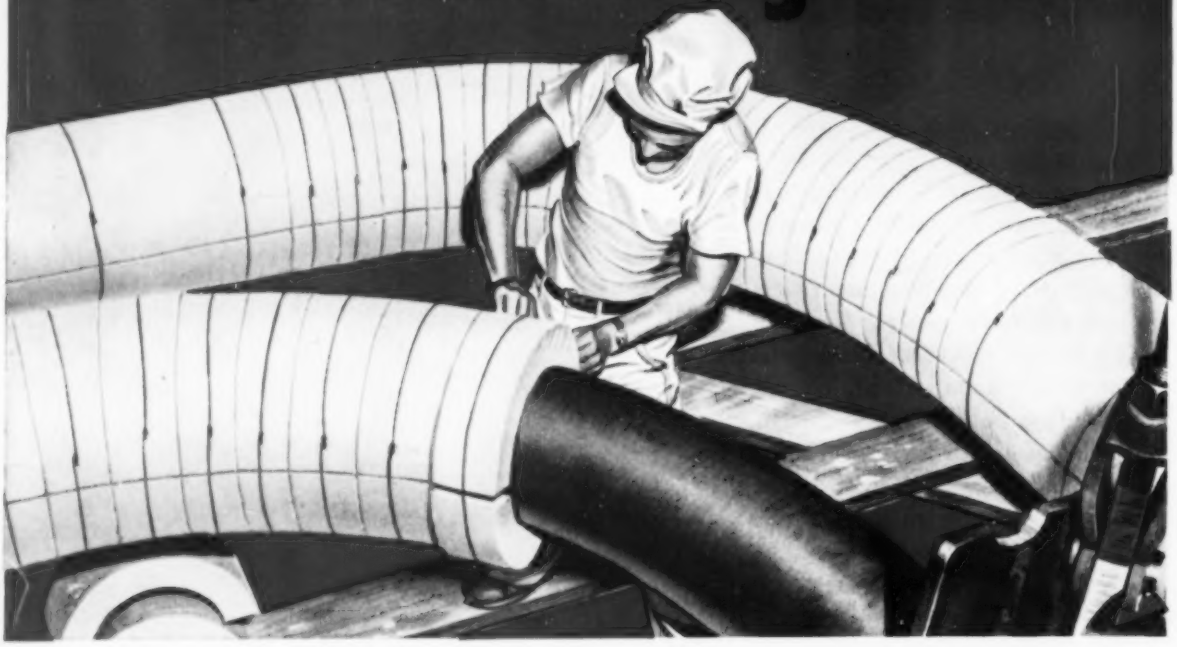
ROCKWELL Built
Nordstrom Valves
Lubricant-Sealed for Positive Shut-Off

Another Rockwell Product

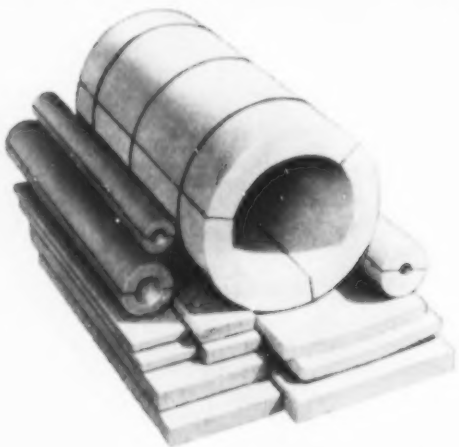


Gear operated semi-steel Nordstrom valve on dry hydrogen supply line on ammonia unit.

How to Get the Most Out Of Your Insulating Dollars



The Right Material . . . Expert Application



First, Kaylo Heat Insulation is *proved* a *better* material—hydrous calcium silicate. Its light weight, strength, water-insolubility, low conductivity and wide temperature range give you extra advantages *at no extra cost.*

Second, Kaylo distributors have the technical knowledge and experience to provide you with a complete insulating service. Their trained applicators are skilled craftsmen who do neat and efficient installation.

To be *sure* of getting the most out of your insulating dollars for your next job, call the nearest Kaylo distributor. Chances are you can find him listed in the yellow pages of your phone book. If not contact us and we'll give you his name.

WRITE FOR FREE BOOK—"Kaylo Heat Insulation." Address: Dept. N-364, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

KAYLO® . . . *first in calcium silicate*

. . . *pioneered by* OWENS ILLINOIS **Glass Company**

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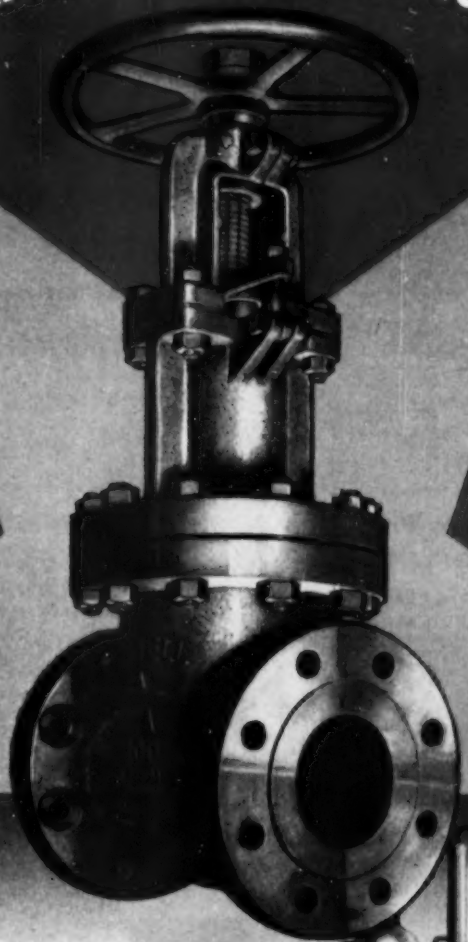
Powell Engineers always look to the future!



DEPENDABLE VALVES SINCE 1846

Fig. 3003 — Series 300-pound, Cast Steel, O. S. & Y. Gate Valve with flanged ends.

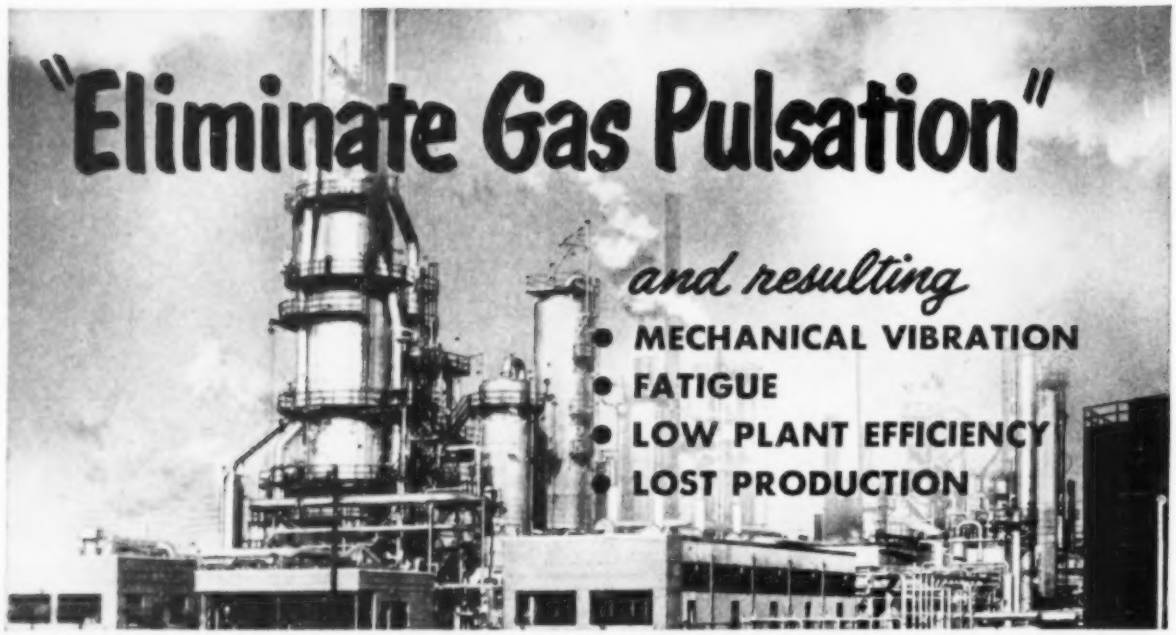
Powell Valves are not only made in every type, size and material needed to meet all your flow control requirements but, because Powell Engineers always look to the future, they give special attention to those important details in design that make all Powell Valves give such long, dependable service and require so little maintenance.

The Wm. Powell Company
Cincinnati 22, Ohio

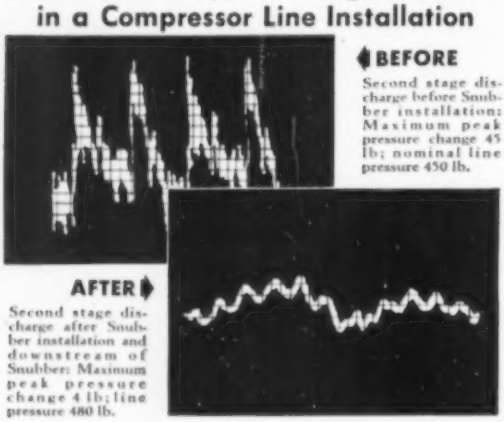
POWELL

BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES

"Eliminate Gas Pulsation"



Solution to a typical Surge Problem in a Compressor Line Installation



BEFORE

Second stage discharge before Snubber installation: Maximum peak pressure change 45 lb; nominal line pressure 450 lb.

AFTER

Second stage discharge after Snubber installation and downstream of Snubber: Maximum peak pressure change 4 lb; line pressure 480 lb.

Send for your copy of a typical Burgess-Manning Pulsation Survey and Analysis Report

BURGESS-MANNING PULSATION SURVEY

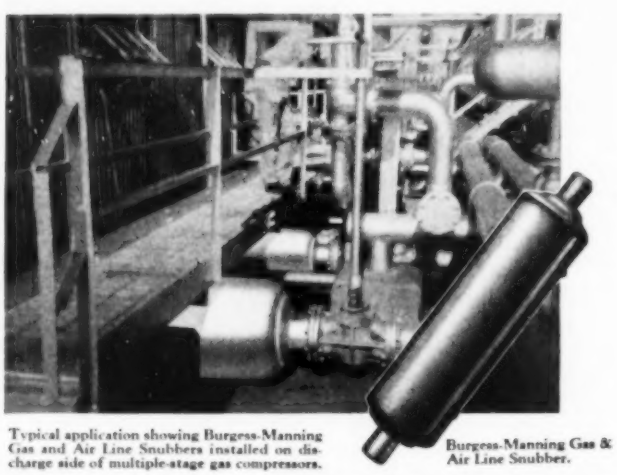
Burgess-Manning pulsation surveys are conducted by trained and fully experienced engineers with electronic equipment including pressure pickup (transducer), amplifier, and oscilloscope. The pressure transducer is coupled as close to the gas stream as possible and faithfully reproduces in voltage the pressure changes in the pipe. This voltage is conducted to a three stage amplifier and then to the oscilloscope screen. Photographs are taken of the screen as a record of surge. Data is taken and recorded. Maximum peak pressure change is calculated. Report is prepared. Recommendations are made that best solve your problems.

CONSULT BURGESS-MANNING ENGINEERS

Gas pulsation in compressor piping systems often results in excessive vibration and material fatigue. This, in turn, necessitates constant maintenance in piping and equipment resulting in lower over-all plant efficiency.

Your compressor system pulsation problem can be solved by Burgess-Manning Company engineers. This division maintains a field service to make surveys and analyses of flow conditions in pressure piping. Trained engineers correlate this data for reference in making Burgess-Manning Gas and Air Line Snubber recommendations for new plants as well as for existing plants.

Write for your copy of a typical case history in which Burgess-Manning engineers solved a tough problem.



Typical application showing Burgess-Manning Gas and Air Line Snubbers installed on discharge side of multiple-stage gas compressors.

Burgess-Manning Gas & Air Line Snubber.

BURGESS-MANNING COMPANY

1203 Dragon Street
DALLAS, TEXAS

Chicago, Illinois — Libertyville, Illinois

REPRESENTATIVES: Houston • Tulsa • Los Angeles • St. Louis • New York

We put 30 years of work into this pin

You've seen plenty of service pins. You may wear one yourself indicating five, ten, twenty-five years of service with your company.

But the pin you see illustrated here is a different kind of pin. We had it made to symbolize thirty years of special service—not to any one company—but to the entire petroleum industry. For it was just thirty years ago—on February 2, 1923—that the first gallon of "Ethyl" gasoline was sold to a motorist and the long list of Ethyl services was started.

We believe this thirty years of experience is one of the most important ingredients in Ethyl antiknock service. For while one pound of antiknock compound may be very much like another—its value to the refiner depends largely on how it is used. From the very beginning, Ethyl has had as its principal objective not

(*Continued on next page*)

ETHYL
ETHYL CORPORATION

Printed in U. S. A.

We put 30 years of work into this pin

(*Continued from preceding page*)

only the efficient manufacture of a product, but the development of services which would help our customers get the most out of that product.

That's why for example, Ethyl has carried out an intensive year-in, year-out advertising and sales-promotion program to promote the premium-gasoline market. That's why we set up the Ethyl Research Laboratories and a network of gasoline testing laboratories. That's why Ethyl pioneered a wide variety of programs, not only in the passenger-car market, but in the bus, truck and farm-tractor fields as well. That's why Ethyl offers numerous safety services, dealer-education programs and technological helps to refiners.

These services are doubly valuable because the men who bring them to you have many years of personal experience. Many of our people wear service pins indicating five, ten and twenty-five years of working with Ethyl for the petroleum industry.

ETHYL CORPORATION

NEW YORK 17, NEW YORK

Ethyl service is backed by 30 years of antiknock experience

RESEARCH

SUPPLY SERVICE

TECHNICAL REPORTS

SALES HELPS

ROAD TESTING

GASOLINE TESTING

for critical corrosive or heat conditions

SPECIFY 'PSC' PROCESS PIPING

You will find PSC offers you this very real advantage in solving heat and corrosion problems. Being independent of all metal producers, we regularly fabricate the complete list of alloys. As a result, when ordering welded tubing from PSC you can choose, from the complete list, the one alloy which will best meet your specific heat or corrosion condition. In contrast, seamless tubing is only available in certain alloys. From PSC you can also order tubing in any wall thickness. In many cases process piping can be lighter than I.P.S. standard. In some, only a light-wall type of construction is practicable. In any case, why pay for heavy wall sections if PSC tubing of money-saving light gauges will serve as well? Also tubing in any diameter or shape. Let us give you details as to how PSC process piping can help solve your problems.

THE PRESSED STEEL COMPANY
of WILKES-BARRE, PENNSYLVANIA

Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

☆ ☆ ☆ OFFICES IN PRINCIPAL CITIES ☆ ☆ ☆

Complete Seating Contact!

You know you've got it with . . .

CHAPMAN

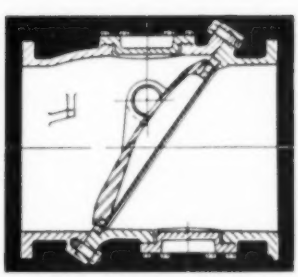
Exclusive TILTING DISC *Check Valve*

Nothing can "unseat" the disc-ring of this valve from its *drop-tight* contact with the body-ring . . . because clearance at the hinge-pins means that this contact is *complete.* There is no sliding action, consequently no wear, no leakage. And the pivoted disc is cushioned to an easy, silent closing . . . without slam . . . in installations that don't have unusual piping arrangements.

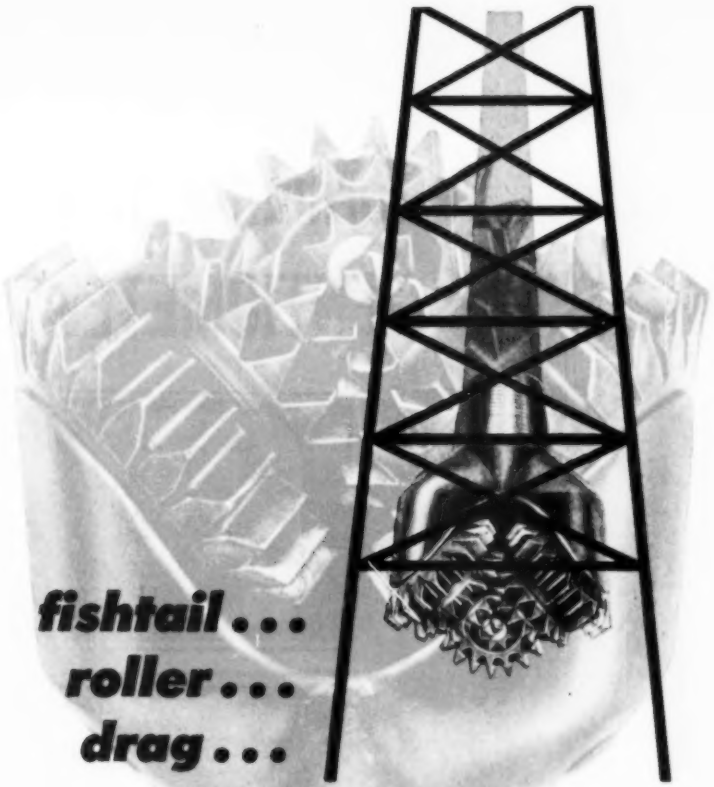
What's more, hydraulic laboratory tests at a top engineering school prove that the specially designed disc and streamlined valve-body reduce head loss as much as 80% under conventional swing-type check valves. See the graphs of these tests . . . and illustrations of the unique construction features of Chapman Tilting Disc Check Valves . . . in Catalog No. 30 (yours for the asking). *Write.*

THE CHAPMAN VALVE MFG. CO.

INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting-Disc Check Valve. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.



"FACE" IT – FOR ADDED SUB-SURFACE TIME!

More than twenty Airco Hardfacing rods are ready to **help you beat** today's replacement delay. Full equipment **protection with** Airco Hardfacing Alloys... for new parts and old... keeps you free of cut-backs, or loss of day-to-day production.

Parts and tools – fishtail bits... roller bits... core heads... wall scraper blades... drag type bits – stay on the job longer, even at peak production, their life extended many times with *Airco Hardfacing Alloys.*

For further information, write today!

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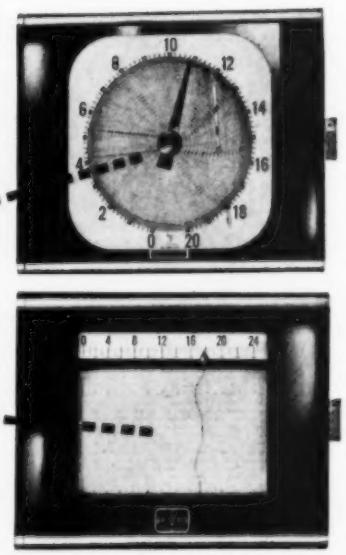
Southwestern Headquarters for Oxygen, Acetylene and Other Gases... Carbide... Gas Welding and Cutting Machines, Apparatus and Supplies... Arc Welders, Electrodes and Accessories

The No. 1 Reason Why You Get a New Brand of Performance from ELECTRONIC DYNAMASTER POTENTIOMETERS

THE SYNCROVERTER INVERTER converts the d-c unbalance signal of a Dynamaster Potentiometer to an a-c signal which is amplified to operate the balancing mechanism.



BRISTOL ELECTRONIC DYNAMASTERS are made in round- and strip-chart, single- and multiple-record recorders and air-operated and electric controllers (all types of control actions). Two-pen and Program Control.

THE BRISTOL SYNCROVERTER IS AN ENTIRELY NEW CONCEPT IN LOW-LEVEL INVERTERS

Because of the superior characteristics of the Syncroverter Inverter:

- Dynamaster Potentiometers are unaffected by vibration and shock.
- Extremely high symmetry of switching action eliminates errors due to a-c pickup in the leads.
- Thermal emf's at the inverter contacts are self-cancelling and thus have no effect on the accuracy of the Dynamaster.

Write for Catalog P1245 for full data on the Dynamaster. Address The Bristol Company, 111 Bristol Road, Waterbury 20, Conn.

BRISTOL

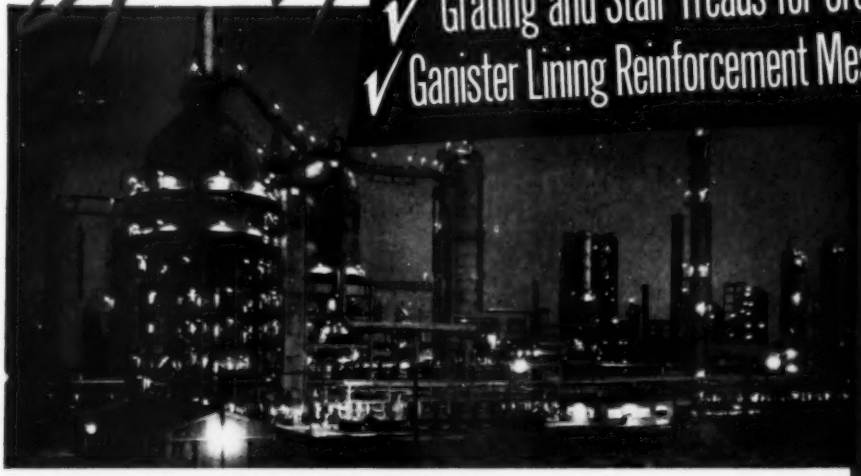
The dependable Guidepost of Industry

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

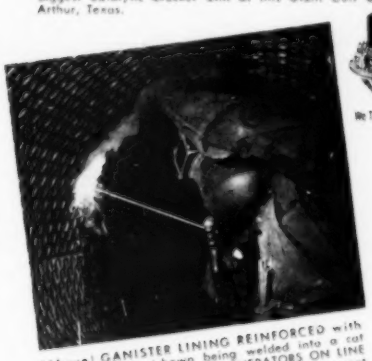
Specify KLEMP

✓ Grating and Stair Treads for Greater Safety

✓ Ganister Lining Reinforcement Meshes for Longer Life



(Above) Thousands of square feet of KLEMP HEXTEEL installed in World's Biggest Catalytic Cracker Unit at this Giant Gulf Oil Refinery in Port Arthur, Texas.



(Above) GANISTER LINING REINFORCED with KLEMP HEXTEEL (shown being welded into a cat cracker) keeps CATALYST REGENERATORS ON LINE Longer. HEXTEEL, when applied, as a reinforcement mesh is filled with a cement filler. This reduces "turnarounds" to a minimum and helps avoid scouring and abrasive actions of the catalyst which can quickly ruin cat crackers and thermal crackers.

(Above) KLEMP FLOORSTEEL, because of its greater flexibility, is used to line the pipes leading to and from the catalyst regenerator. FLOORSTEEL is ideal for silencer stack units and also protects the narrow throat of the catalyst regenerator.

We Tread the World with Safety

The Klemp Metal Grating Corporation has been serving the needs of the Oil Companies for almost Half A Century. During this time Klemp has produced and patented several specialized gratings, such as HEXTEEL® and FLOORSTEEL® reinforcement meshes for use in fractionating vessels for the Oil, Chemical and Petro-Chemical industries.

KLEMP DIAMOND RIVETED and KLEMP KREST WELDED GRATINGS are consistently specified for stair treads, walkways, landings, tower stairs, catwalks, stairways and many other applications.

We are the only grating company to do all of our own work and we have complete fabricating facilities from complicated radial "set-ups", down to simple runs. Our engineers have spent a lifetime in this business and their specialized experience is at your service. We solicit the opportunity to solve your most difficult grating problems.

Write for Klemp's two new, free, fully illustrated technical catalogs, titled—

KLEMP 4 "Grates" serving the Nation's Major Oil Companies

KLEMP Open Steel Grating And Stair Treads

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Mr. C. G. Ehlinger
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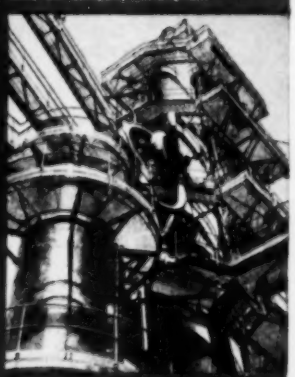
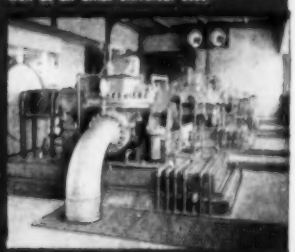
KLEMP

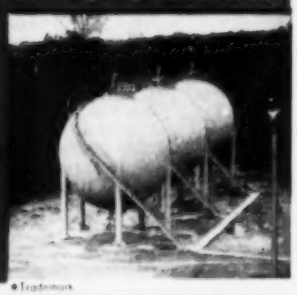
(Below) DIAMOND RIVETED GRATING serves for strong, clean, non-slip, fireproof, ventilated catwalks, mezzanines, stairways and platforms, prefabricated to your most exacting specification. Shown here is a Shell Oil Company installation.



(Below) NEW KLEMP KREST* WELDED GRATINGS are made from special steel bars so formed to provide a peak or krest on the top side of the bar which gives this type of grating maximum non-slip characteristics. Ideal for structural foot walks as well as all other universal uses.



(Below) Klemp Manufactures Diamond Riveted, Welded and Serrated Stair Treads. This Serrated Tread has been developed especially for installations where unusual precautions are necessary to avoid accidents resulting from grease, mud, snow, etc.



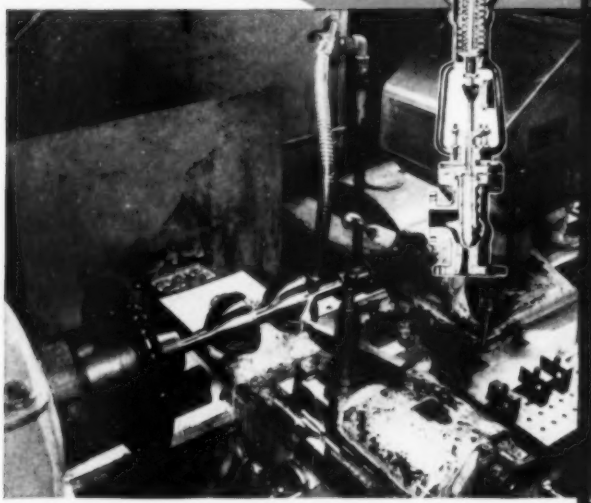
*Trademark

KLEMP METAL GRATING CORPORATION

Plants & Warehouses at CHICAGO, ILLINOIS and HOUSTON, TEXAS

Close Tolerances at the BS&B Climax Controls Factory

1.

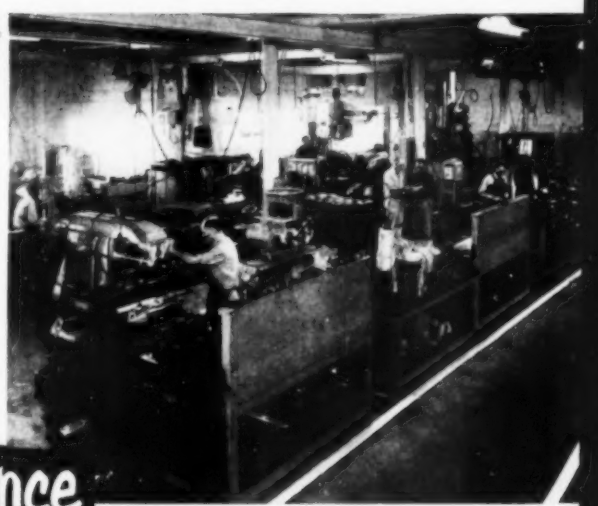


You demand controls designed and engineered by men thoroughly familiar with your industry. You demand the manufacturer be stingy with his tolerances . . . a stickler for exacting accuracy for you know that on such accuracy may depend your cost of operation—the safety of your equipment—the lives, even, of your people.

That's why we know we're being complimented when so many precision minded industries rely so completely on BS&B Climax Controls—they **trust** our knowledge and above all, our **care** in manufacture. BS&B Climax engineers protect this enviable reputation by constantly watchdogging the production of the Climax instrument that safeguards your control of pressures, temperatures, levels and flow.

And safety is not the only benefit Climax Controls may give you. Wide awake industries have found that Climax valves, controls, regulators or relays can in many cases . . . (a) eliminate manual operations, (b) vary, increase or multiply the functions of equipment, (c) supply additional safety factors, (d) reduce supervisory requirements.

2.



Generous Control Performance

Performance and reliability show up in the manufacturing of Climax Controls. Here are a few of the steps that enable us to turn out over 12,000 different parts used in the assembly of various Climax Controls.

1 **"Peas-in-a-pod" Uniformity.** An electronic-hydraulic duplicator reproduces every inner valve from a template within .001" tolerance, assuring uniform inner valve characteristics.

2 **Part of the modern and orderly Climax Controls** factory . . . milling machines, deburring and grinding bench, drill presses and boring mill. Skilled and experienced operators contribute heavily to your control application where the name Climax appears.

3 **Applying Craftsman's touch to Mass Production.** For economy, which is passed along to you, Climax Controls are produced on an assembly line basis . . . for accuracy, which you enjoy in true performance, a Climax Control is never without the Craftsman's touch. Here a large multiple spindle drill works true bolt circles in a large body. A similar but smaller unit does the same job for smaller parts.

3.

76 Climax Control Centers . . . Ask Your BS&B Man

Call on BS&B for confidential Climax Engineering Service. A Climax control engineer will help you. A Climax control problem or application, for information and work out structions, specifications and engineering of specification sheets. Write for BS&B Climax Controls Catalog.

EFFICIENCY BS&B RELIABILITY OUR 50th YEAR

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Climax Controls Division
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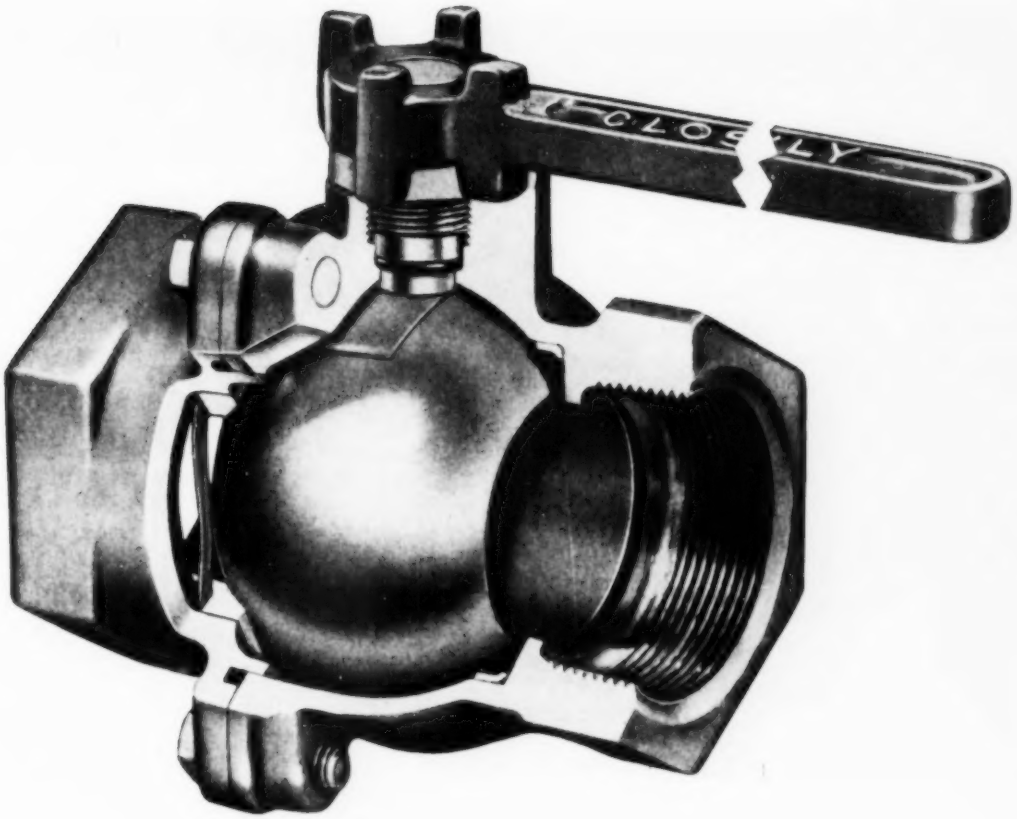
Kansas City 3, Missouri



NEW BALL VALVE

gives you more of what you want in a valve

Full round flow... as full as if there were no valve in the pipe at all. Handles fluids with minimum friction loss . . . without turbulence.

Quick opening . . . Quick closing... even under full pressure. Needs only an easy quarter turn.

Resists wear longer . . . chrome-plated floating bronze ball is extremely resistant to scratching, pitting, abrasion.

Stays leakproof . . . When valve is in closed position, pressure of fluid automatically positions ball against synthetic rubber seat to form a tight seal.

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APPROVED BY UNDERWRITERS' LABORATORIES, INC.

Among the many satisfied users of Rockwood Ball Valves are:

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Bird Machine Company
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ROCKWOOD

ROCKWOOD BALL VALVES

ROCKWOOD SPRINKLER COMPANY

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REQUIRE PRECISE TEMPERATURE CONTROL?

Thermo Electronic TEMPERATURE CONTROLLERS

provide
NULL BALANCE ACCURACY
ELECTRONIC SENSITIVITY
AND SPEED

AT LOW COST

Now, with Thermo Electronic Controllers, thermocouple and resistance bulb types, you can afford accurate, automatic temperature control on processes and equipment operating between −100°F and 3000°F. The two-position control action is continuous and high speed, only one part—a magnetic control relay—moves positively when the process calls for a change of heat. Both types of controllers incorporate a null balance circuit for high measuring accuracy with an electronic control system for sensitivity and speed. Calibration is guaranteed to within plus or minus ¼ of 1% of full scale range. Bright signal lights indicate temperature conditions and are clearly visible over wide angles and great distances.

Outstanding features of Thermo Electronic Controllers are simplicity of design and sturdy and compact construction. They are easy to install, economical to operate, and require little maintenance. Severe vibration or mechanical shock will not affect the measuring accuracy or control sensitivity.

TELL US ABOUT YOUR TEMPERATURE CONTROL PROBLEM OR WRITE FOR

Thermocouple Pyrometer Controller Bulletin 50 X
Resistance Bulb Controller Bulletin 55 X

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Protection Tubes
Quick Coupling Connectors
Thermocouple and Extension Wires
Resistance Bulbs
Connector Panels

Thermo Electric Co., Inc.
FAIR LAWN NEW JERSEY

Long-lasting Stainless Steel

reduces maintenance at Gulf's Lube Oil Phenol Extraction Plant

IN job after job, Stainless Steel repeatedly has demonstrated its ability to reduce maintenance and resulting downtime through its excellent resistance to corrosion and other severe conditions so often encountered in the petroleum industry.

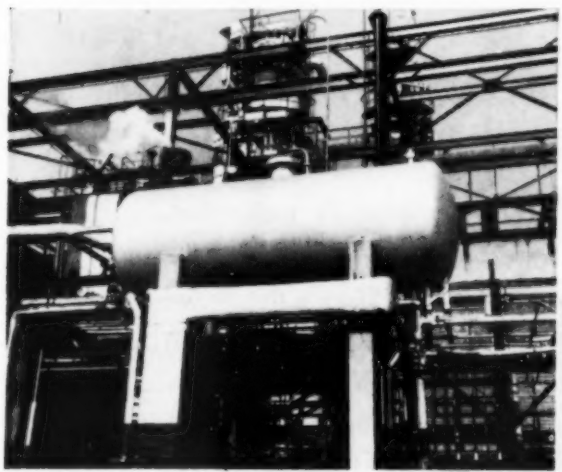
For example, in the Lube Oil Phenol Extraction Plant (Multisol No. 3) at Gulf Oil Corporation's Port Arthur, Tex., operation, three specific installations of Stainless Steel have played an important role in reducing over-all downtime.

The phenolic water accumulator—handling a solution of 10% phenol and some naphtha—is lined with Stainless Steel 5/64" thick and 12" wide. It has been in service for nine years and remains in good condition, although carbon steel plates used previously blistered after two years of service. The vessel operates at a pressure of 5.0 psi and at 170°F.

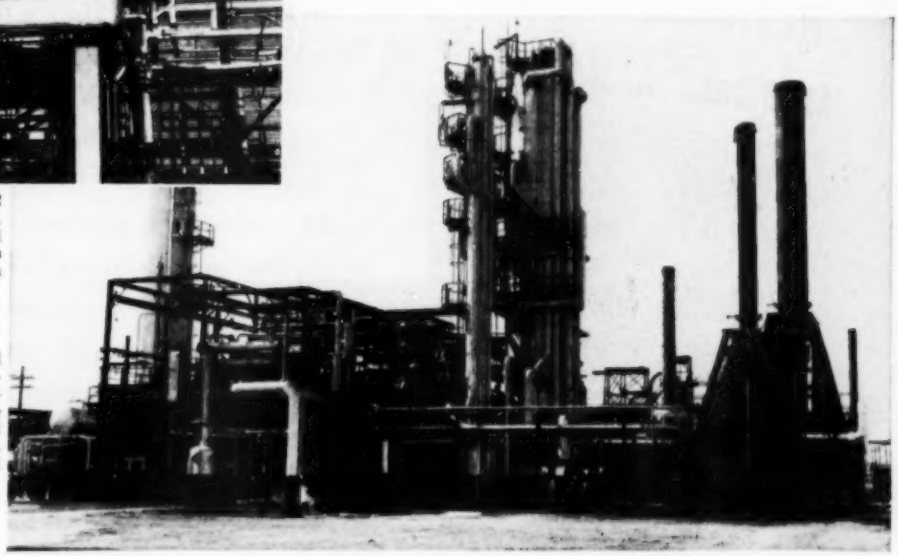
In the extract heating furnace, the last 16 tubes are Stainless Steel and have been in service for 7½ years without need for maintenance. Carbon steel tubes in these locations failed after 18 months of service.

The drier section of the phenol tower itself is lined with Stainless Steel as a protection against rapid corrosion at tray level.

There are many locations in your plant where the proper grade of Stainless Steel can help you maintain uninterrupted production. Our metallurgical and research personnel will be glad to assist you with recommendations. There is no obligation, of course.



PHENOLIC WATER ACCUMULATOR is lined with Stainless Steel. The Stainless lining has lasted nine years—against two years for carbon steel—and is still in serviceable condition.



OVER-ALL VIEW of Lube Oil Phenol Extraction Plant (Multisol No. 3) at Gulf Oil Corporation, Port Arthur, Tex. The phenol tower is in the center and the extract heating furnace at the right. Both are equipped with Stainless Steel.

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
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SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

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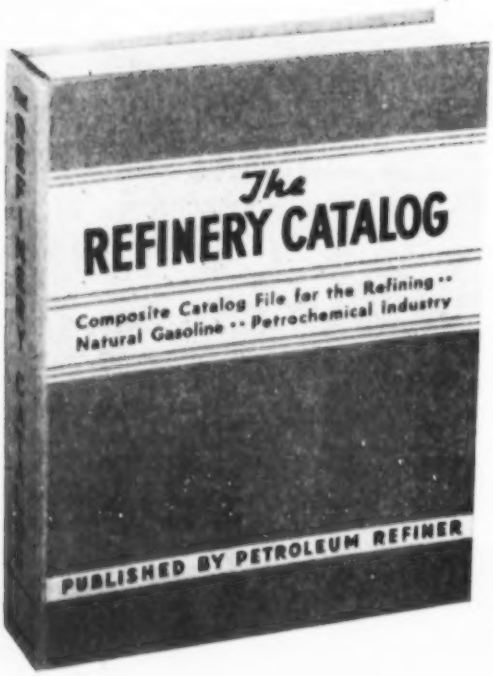
UNITED STATES STEEL

NO. 1 *Time Saver* FOR REFINERY MEN


The
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PUBLISHED BY PETROLEUM REFINER

WHEN you have to make fast, accurate buying decisions, use the Refinery Catalog. Here's the Refining Industry's universal equipment guide . . . containing the information you need for adequate comparisons of hundreds of different types of services and products.

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For over 50 years it has been the mark of a project in capable hands. It stands firmly on a world-wide record —the designing, engineering and constructing of nearly 700 units of all types for manufacturing the full range of petroleum products, and for making the world's most-needed chemicals and petrochemicals.

It's a good sign to rely on when you buy complete, integrated engineering service for your next project.

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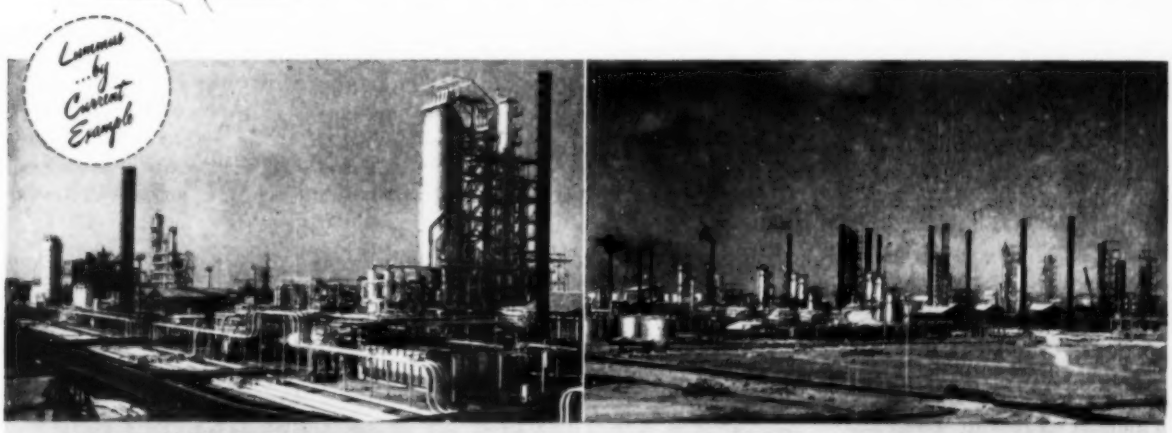
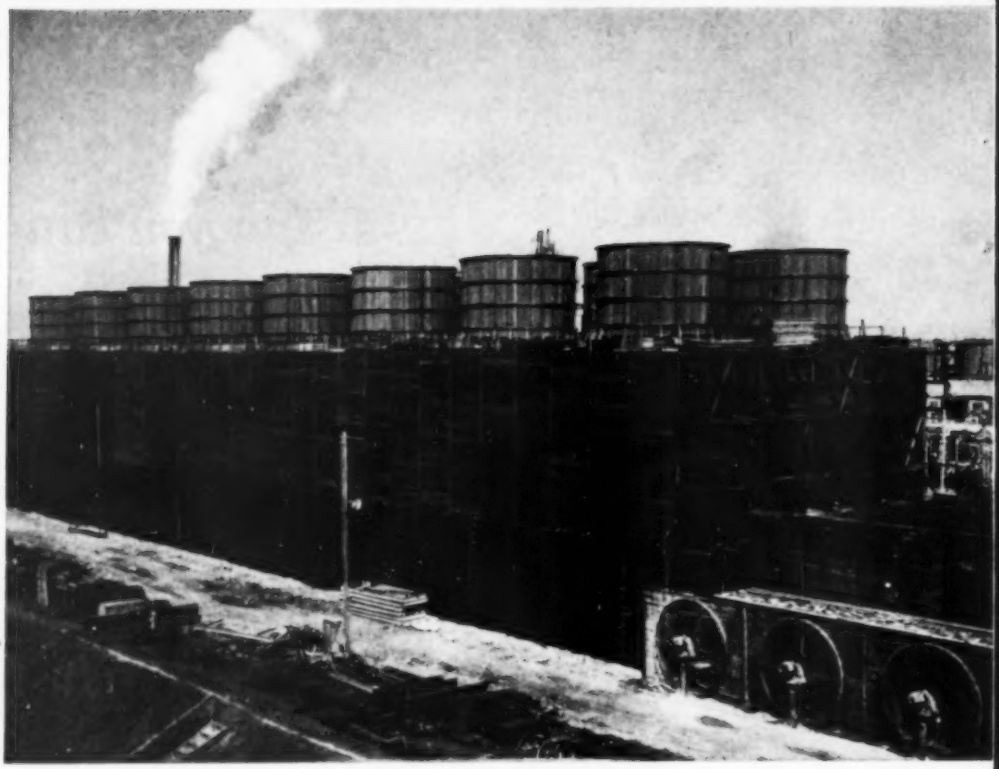
DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES



COMPLETE REFINERY IN FRANCE. This is a partial view of Société Générale des Huiles de Pétrole's complete oil refinery at Dunkirk which alone makes available about 1¾ million gallons per day of a full range of petroleum products for French industrial and domestic uses. Practically all processing units in this refinery were designed, engineered and built by Lummus.

COMPLETE REFINERY IN VENEZUELA—a project in which Lummus played a major role by designing and engineering most of the processing units, and constructing all of them. Covering 3,150 acres, this refinery handles 170,000 barrels per day of petroleum—almost one-half of Venezuela's total refining capacity. Owner: Shell Caribbean Petroleum Company.



View, showing 16 cells of new Foster Wheeler cooling tower erected on foundation of old tower. Portion of old tower, shown at right, was replaced by 8 cells of new tower.

Tailored to fit customer plant conditions!

THE ERECTION of this new 24-cell cooling tower on the same foundation as the 56-cell tower which required replacement, without interruption in cooling capacity, is another example of the ability of Foster Wheeler to tailor the job to conditions in the customer's plant.

To assure a continuous supply of cooling water while the new tower was being built, 30 cells of the old tower were razed and the remaining 26 cells connected to two smaller existing towers by a temporary flume. The first 16 cells of the new tower were then erected and put into operation in time to meet the oncoming summer heat load. The remainder of the old tower was then removed and the balance of eight new cells erected.

It is through such unusual types of installations that Foster Wheeler has gained the reputation for engineering and construction excellence.

FEATURES OF THIS INSTALLATION:

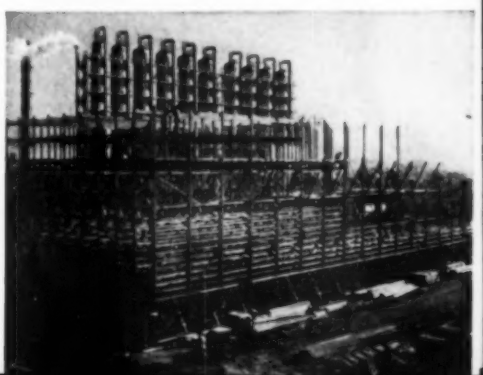
Combination cast iron and red brass distribution system, with 720 special full coverage red brass up-spray nozzles, provides uniform water distribution over a wide variation in water flow rates. Induced-draft fans with 16-foot stacks discharge tower vapors at a high velocity 60 ft. above basin curb—reducing recirculation to a minimum.

The new tower requires 4320 sq. ft. less ground area than the old tower—enough to allow for the addition of four 30 ft. by 36 ft. cells for future requirements.

* * *

DESIGN CONDITIONS

Capacity	48,000 U.S. gpm
Inlet water temperature	120° F
Outlet water temperature	85° F
Wet bulb temperature	80° F



FOSTER WHEELER CORPORATION, 165 BROADWAY, NEW YORK 6, NEW YORK

FOSTER WHEELER

dried 3,000 years

. . . for quick-dried petroleum products you need Alcoa Activated Alumina

The petroleum industry has learned to rely on Alcoa Activated Alumina for the quick, efficient dehydration of liquids, gases and vapors so essential in maintaining production schedules. Thoroughly proved, Alcoa Activated Alumina has had a long and successful history in the drying of propane . . . butane . . . gasoline . . . distillate . . . residue gas . . . and scores of other petroleum products. Its desiccating properties have been equally effective in protecting finished oils from water contamination and in maintaining continuously-dry instrument air.

Commercially pure, Alcoa Activated Alumina has outstanding stability of physical form . . . will not break down due to repeated cycles of saturation and reactivation. Does not soften, swell or disintegrate in liquid water. Alcoa Activated Alumina is non-corrosive and practically iron-free.

Alcoa Activated Alumina dries to lower dew points than any other commercial desiccant. Moreover it adsorbs certain gases from gaseous mixtures and serves as a catalyst and catalyst carrier. If you are not already enjoying the economies it offers, write to:

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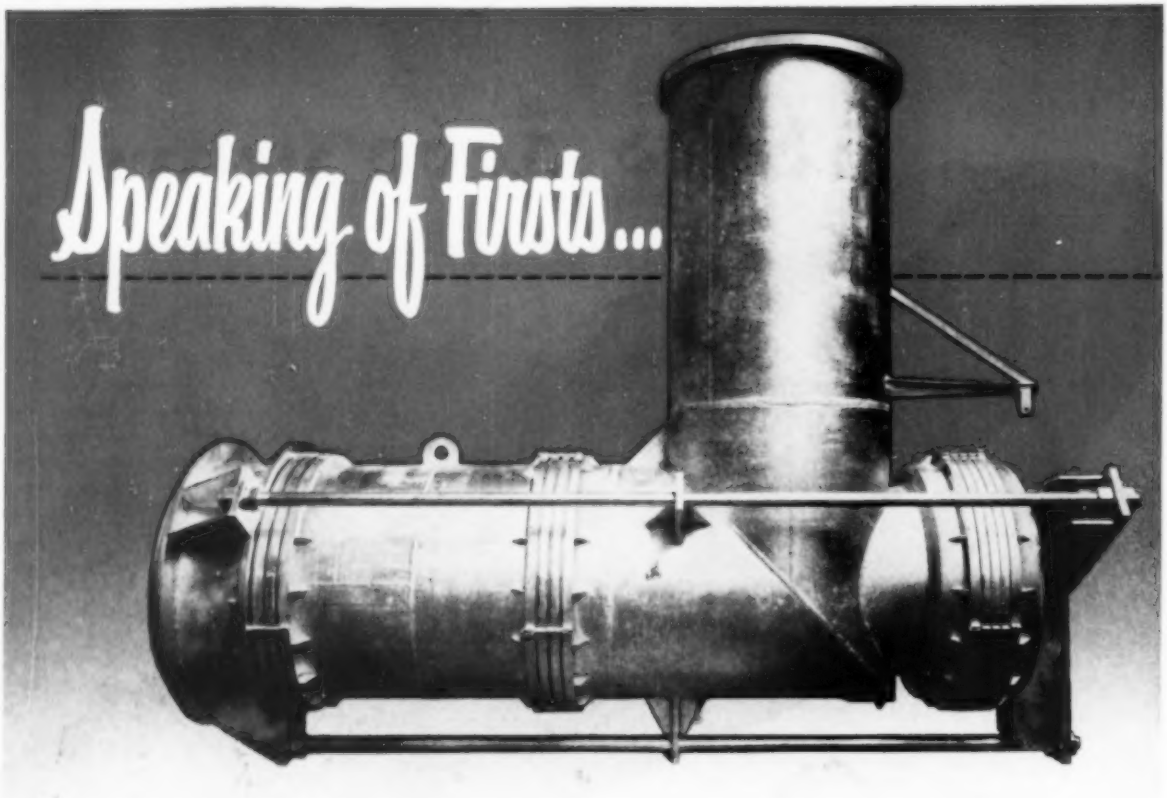
Speaking of Firsts...



Recently, Zallea was given the assignment of developing a group of 48-inch expansion joints for flight propulsion test facilities on a classified defense project. The rigid technical specifications of this advanced application required "tailor-made" units for the job, so Zallea engineers analyzed the problem and designed the unusual-looking joint pictured above . . . the first of its kind. Actually, it is a Balanced Pressure, Universal Self-equalizing expansion joint, originally developed by Zallea engineers in 1945, operating at 165 psi and incorporating internal stainless steel turning vanes to provide a smooth flow of gases through the right angle bend. The unit absorbs 3" axial and 1.27" lateral movements through a temperature range from −100° F. to +650° F. No anchors are required since this arrangement neutralizes end thrust developed by internal pressures.

This example is representative of our ability to cope with the most difficult expansion joint problems. It is our business to specialize in the design and manufacture of one product only—expansion joints—and over the years we have learned how to solve the "tough ones" effectively and quickly.

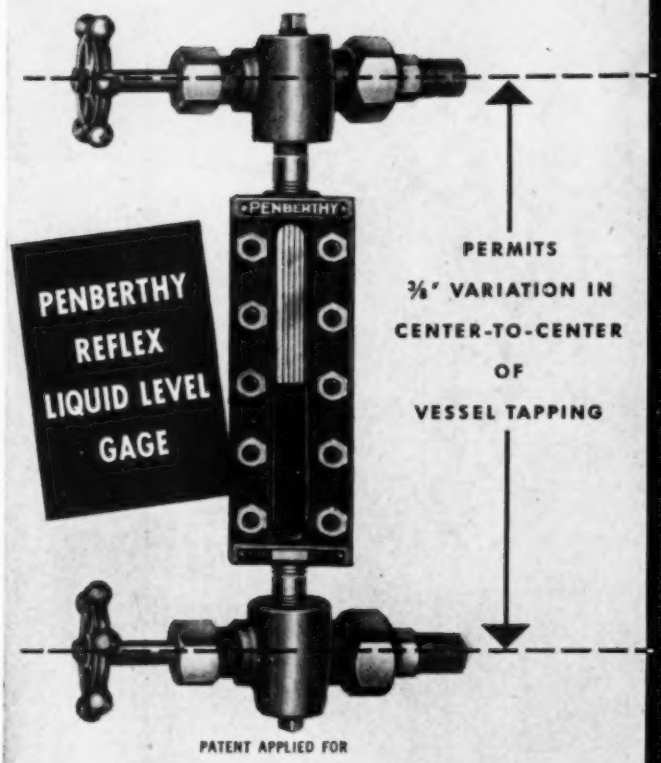
Zallea Expansion Joints are available in diameters from 3 inches to 30 feet . . . for temperatures from sub-zero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs, and up to 2,000 psi in special designs.

The next time you are faced with an expansion problem, get in touch with us. We will be glad to survey your situation and recommend the most practical and economical solution. Zallea Brothers, 890 Locust Street, Wilmington 99, Delaware.

For detailed information on Zallea Expansion Joints and services write today for a free copy of Bulletin 351.

Zallea
EXPANSION JOINTS

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS



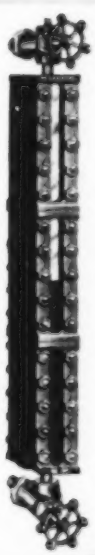
PATENT APPLIED FOR

Another PENBERTHY First

PENBERTHY "Floating Shank"

Saves Time and Money in Gage Installation

A feature available only on Penberthy drop forged steel (and alloy) gage valves, the "floating shank" automatically compensates for as much as ⅜" variation in the center-to-center distance of the vessel tapping. This saves time and cuts the cost of gage installation . . . eliminates stresses often induced during mounting. Penberthy "floating shank" is available at slight additional cost. It will pay you well to specify "floating shank" on your next gage order.



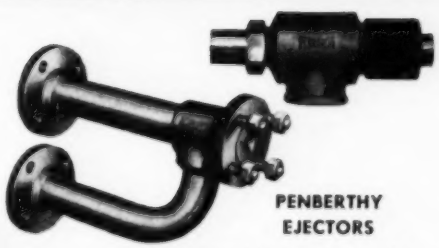
OTHER PENBERTHY PRODUCTS

PENBERTHY TRANSPARENT GAGE

Used to observe color and density of liquids under high pressures and/or temperatures. Exceptionally sturdy construction—liquid chamber machined from solid block of metal. Ask for Catalog 35.

PENBERTHY CYCLING JET PUMPS

Automatically operated by air, gas or steam pressure . . . Will pump without clogging any liquid that will flow through pipes. Ask for Bulletin 5030.



PENBERTHY EJECTORS

A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Made in wide variety of materials and special units developed to meet unusual conditions. Ask for Bulletin 512.

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PENBERTHY INJECTOR COMPANY

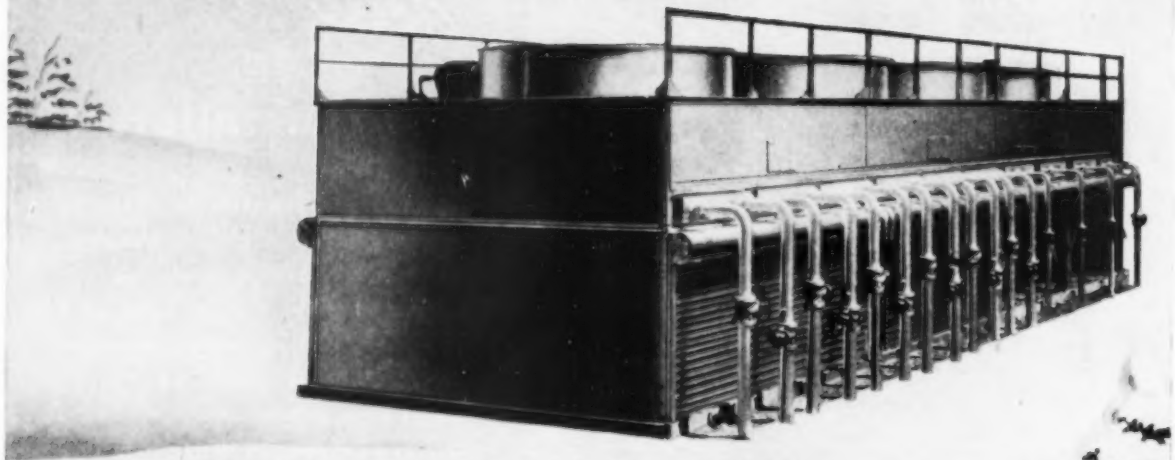
DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

DETROIT 2, MICHIGAN

Established 1886 — *Canadian Plant, Windsor, Ontario*

MARLEY DRICOOLERS®

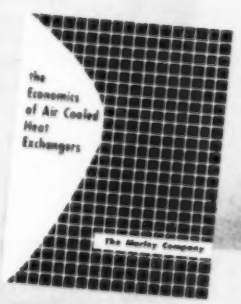
take winter in stride...



Maintaining correct process temperatures in all kinds of weather . . . that is the job DriCooler air cooled heat exchangers are engineered to do and they do it! How well they do it is best attested by the experience of DriCooler operators in the Northwest and other sections of the country where sub-zero temperatures are common.

These operators know that DriCoolers in their plants are engineered for any conditions the elements offer. They know that at 30 and 40 degrees below zero there will be no days or nights of intense effort to keep plants running in spite of frozen tube sections, fan icing or other winter-caused difficulties. All have full confidence that their plants will go on delivering gas or electricity in a smooth routine manner because they have the benefit of Marley's broad experience in designing DriCoolers to meet frigid conditions.

Marley engineering gives as much consideration to low temperatures as to high temperatures. Marley uses (and uses correctly) the most modern techniques to aid the operator in maintaining design temperatures the year round. DriCooler induced draft design protects tube sections by placing them below the plenum chamber where they are not exposed. It keeps the fan in the warm air stream where it cannot accumulate ice. Add to this the control of intake air by easy rolling steel doors or by multi-vane shutters and you have the one air cooled heat exchanger that knows no climatic barriers . . . you have the Marley DriCooler.



Write for a copy of this brochure. It gives very complete information on application of DriCoolers in YOUR business. Address Department DC2.

MARLEY

The Marley Company

Kansas City 5, Missouri

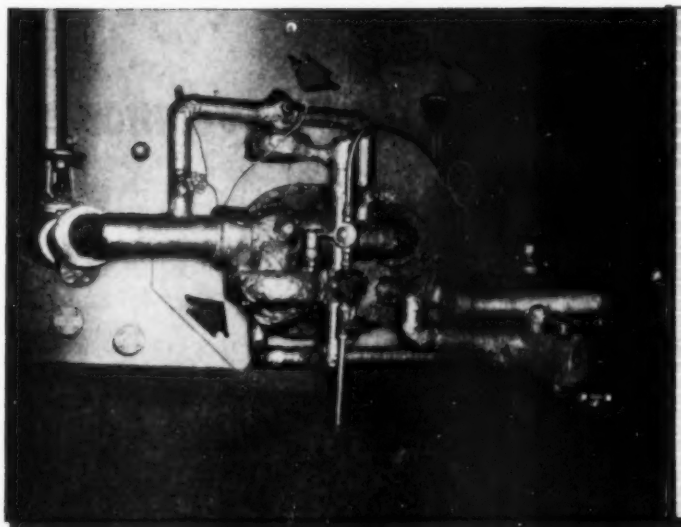
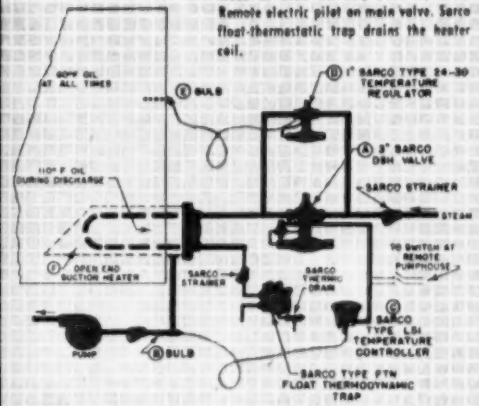
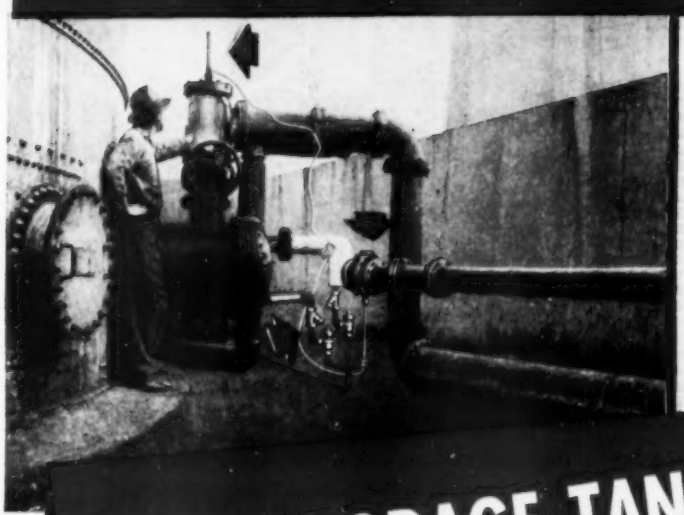
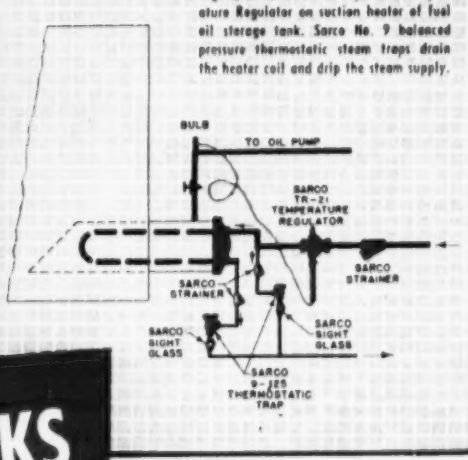


Fig. 1, Sarco type 24-30 self-contained, pilot-operated Temperature Regulators on bulk storage tanks. One of 13 installations made at Shell Oil Co., Sewaren, N. J. Remote electric pilot on main valve. Sarco float-thermostatic trap drains the heater coil.





● Fig. 2, Sarco TR-21 self-operated Temperature Regulator on suction heater of fuel oil storage tank. Sarco No. 9 balanced pressure thermostatic steam traps drain the heater coil and drip the steam supply.



BULK STORAGE TANKS

● SUCTION HEATERS, as widely used to bring heavy fuel oil in bulk storage to pumping temperature, require *fast acting* temperature control. All the controlling must be done while the oil is drawn off through the heater.

The control valve must be of the dead-end, *tight shutoff* type to prevent running away of the temperature when no oil is pumped out.

Sarco self-contained, pilot operated regulator, type 24-30, (Fig. 1) meets these requirements perfectly and will hold delivered fluid temperature constant within close limits.

Fig. 2 is a simplified hook-up for low pressure steam, using self-operated regulator, type TR-21

Send for a Questionnaire or write for Catalog 600-14, to Sarco Company, Inc., Empire State Bldg., New York 1, N. Y. Branches in principal cities. Sarco Canada Ltd., Toronto 8, Ont.

Sarco self-operated Temperature Regulator, type TR-21, sizes ½" to 8", for low pressure steam.

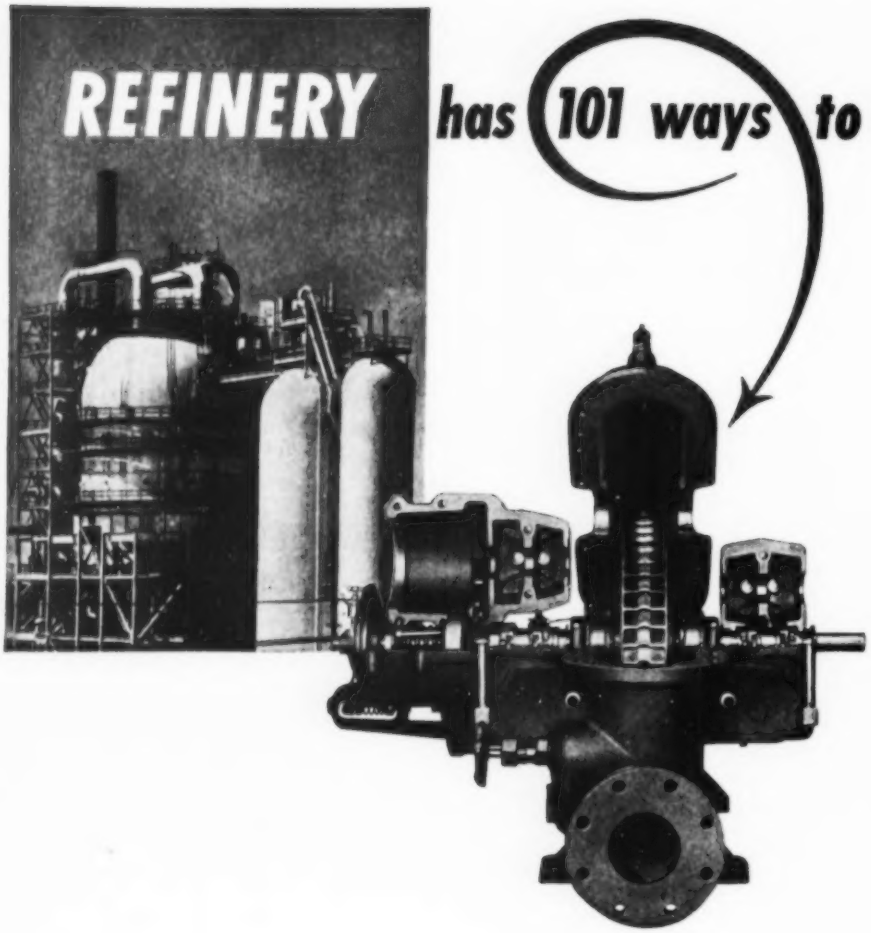
Sarco pilot-operated Temperature Regulator, type 24 30 for dead-end service and high steam pressure.

A Sarco pipeline strainer should be ahead of every regulator to keep out dirt and scale.

SARCO saves steam
improves product quality and output

418

REFINERY has 101 ways to save money



When the yearly cost of replacement parts for 101 steam turbines averages *only 1.6% of the initial investment,* you are saving money . . . and plenty of it.

This amazing record was established by Terry turbines at a large refinery on the Atlantic coast. The percentage figure was determined by means of an accurate tabulation of the cost of replacement parts required over a two-year period.

These 101 Terry machines provide a good cross section of the various types of small and medium-size turbines made by the company. Ranging in size from 10 to 1200 horsepower, they include single and multistage axial flow designs as well as the famous Terry solid-wheel turbine.

Such outstanding performance records are not at all unusual for Terry turbines. The thousands and thousands of these machines installed in refineries throughout the world provide an accurate yardstick for measuring turbine reliability.

Send for illustrated bulletins. No. S-116 describes the many advantages of the Terry solid-wheel turbine. For multi-stage turbines, ask for a copy of Bulletin S-146.

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THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

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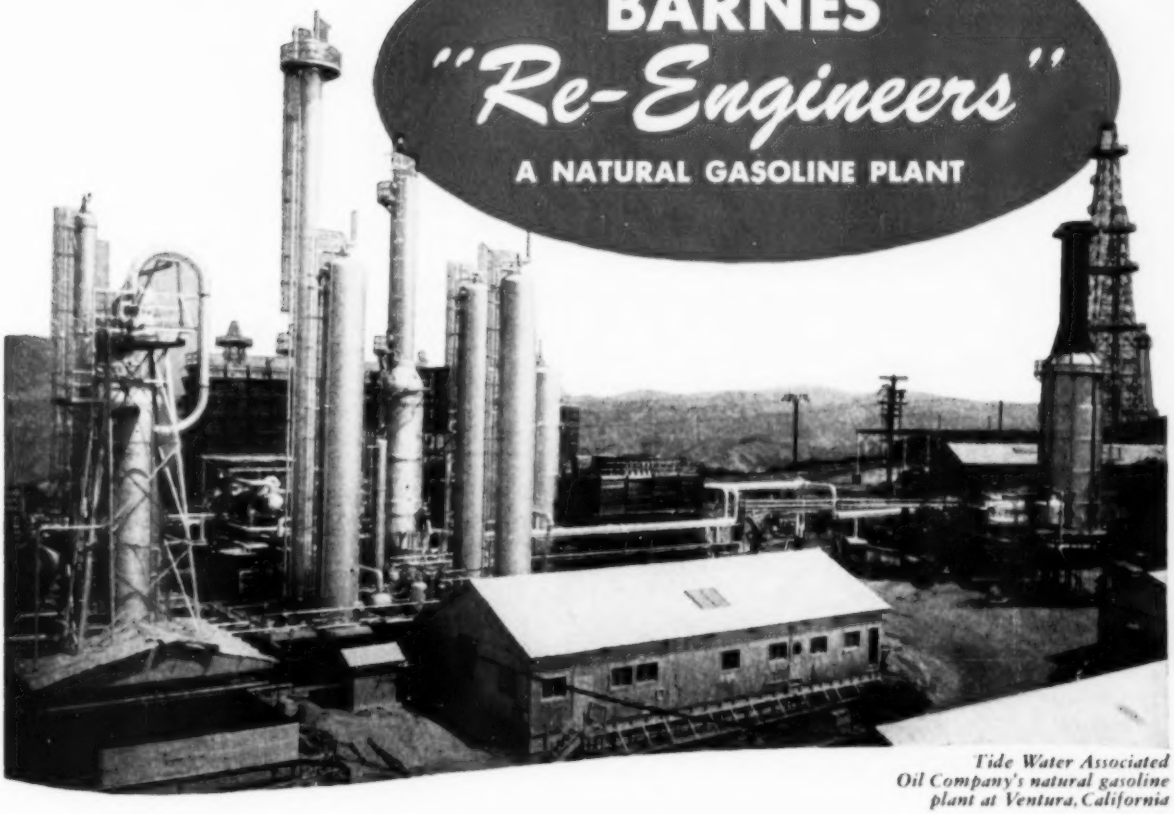
BARNES "Re-Engineers"

A NATURAL GASOLINE PLANT



Tide Water Associated Oil Company's natural gasoline plant at Ventura, California

. . . and provides the customer with these advantages

1. *. . . a substantial increase in propane recovery.*
2. *. . . a higher purity of the propane.*
3. *. . . a reduction in operating cost.*

This "re-engineering" job recently completed for the Tide Water Associated Oil Co. is typical of the *custom engineering* Barnes offers the petroleum industry. In this particular case an existing plant formed the basis for operations. New plant equipment was installed and procedure recommendations were made which resulted in an increase in plant efficiency and throughput.

With a record for getting things done quickly and smoothly Barnes is called upon by leading oil companies for all types of jobs. Whether it's moving a complete refinery from one side of the world to the other, or the designing, engineering and construction of a specific plant in the petroleum or petrochemical field, or the "re-engineering" of an existing plant . . . you can depend on the Barnes organization *from start to finish!*

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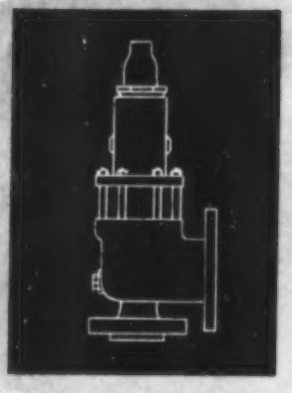


SAFEGUARDED AGAINST CORROSION...

Bellows Sealed

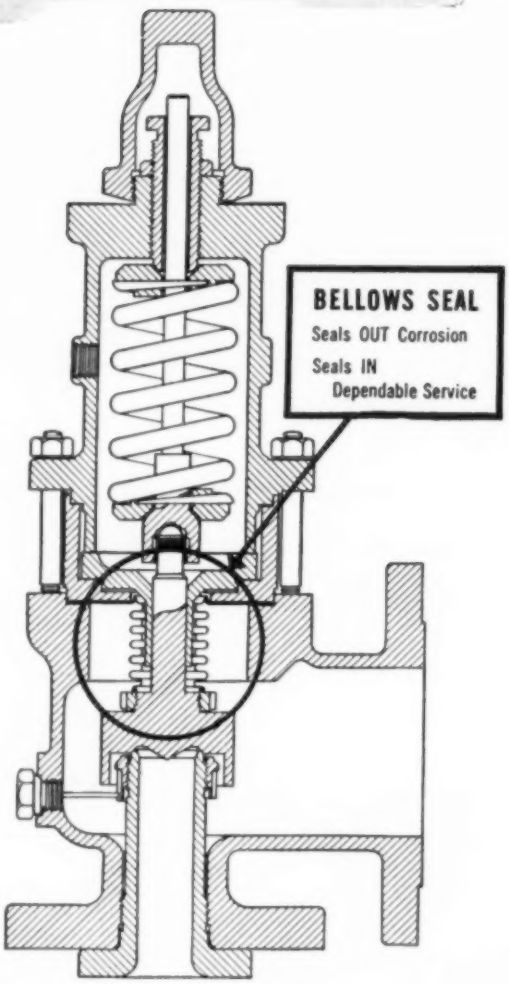
CONSOLIDATED SAFETY RELIEF VALVES

CORROSIVE LIQUIDS OR GASES cannot attack the spring and guiding surfaces between the disc guide and disc in these Consolidated Safety Relief Valves. The BELLOWS SEAL encloses them in an armor of stainless steel — protects these vital parts against corrosion — assures continuous, dependable valve operation. Because the bellows is long and soft, you can be certain of optimum performance of the valve in service.

AISI TYPE 316 STAINLESS STEEL is used in the standard bellows of these valves. If the corrosion-resistance of another material is better suited to your process, and a bellows can be fabricated from it, we will let you know the cost of valves of such construction upon request.

VARIABLE BACK PRESSURE SERVICE is permissible for Bellows Sealed valves, provided gauge back pressure variations do not exceed 15% of the gauge set pressure. In such applications, the set pressure and blowdown are constant, within practical limits, when the valve is subjected to variations in downstream pressure.

BELLOWS SEALED Consolidated Safety Relief Valves have every other superior design and construction feature to assure continuous, economical performance at their rated capacities. Get all the facts about their quality and "safety-first" dependability.



CONSOLIDATED SAFETY RELIEF VALVES

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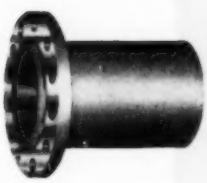

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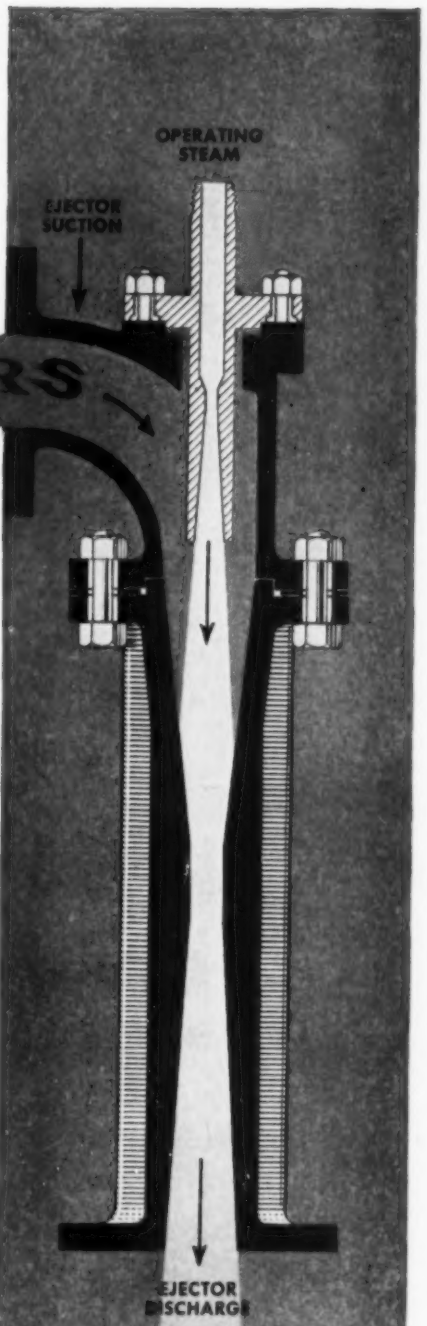
Where processes call for vacuum pressures down to 50 microns (.002" Hg abs), the I-R Steam Jet Ejector can generally make important savings in first cost, installation, operation and maintenance.

The steam jet ejector is the ultimate in mechanical simplicity, consisting of only three basic parts—a steam nozzle, a suction chamber and a venturi-shaped diffuser. There are no moving parts to wear out or require lubrication—no vibration—nothing to adjust or replace. Little or no foundation is required and space requirements are very moderate.

Ingersoll-Rand can supply Steam Jet Ejectors, designed for any capacity requirements within their vacuum pressure range. They will handle wet or dry mixtures of air, gases and vapors, and accidental entrainment of liquid will do no damage. I-R Ejectors are available in single-stage, two-stage, and multiple-stage designs—with pre-coolers, intercondensers and after condensers as required for any specific application.

Remember, I-R engineers are specialists in vacuum-producing equipment—including both steam-jet ejectors and reciprocating vacuum pumps. Their recommendations for *your* vacuum equipment are therefore based solely on your own best interests. For further information, consult your nearest I-R representative. Or write for a free copy of Bulletin 9013A.



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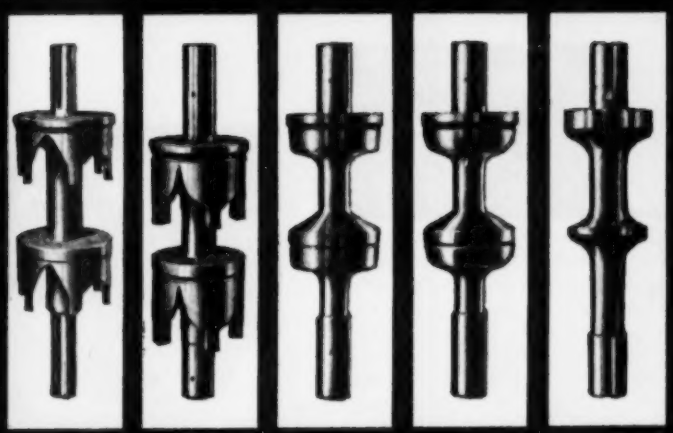
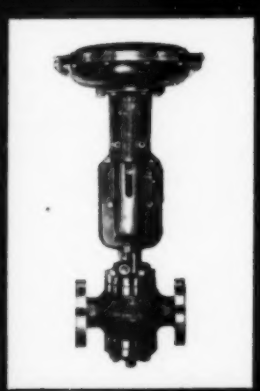


for any valve application



Discs for the Honeywell Series 700 Valve include single and double-seated V-ported and contoured types, each with either linear or equal-percentage characteristics, plus a flat disc for on-off control . . . all ground and polished . . . all designed to retain characteristics under severe service. The Honeywell Series 700 Valve comes in a full range of styles and sizes . . . has *all* the features you look for in a fine valve. Write today for your copy of Bulletin 700-2. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division,* 1907 Windrim Avenue, Philadelphia 44, Pa.

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When you need metallic gaskets for high pressure piping, put the job up to Johns-Manville Goetze Gasket specialists. You benefit in many ways:

You get the exact gaskets you need for maximum efficiency under *your* operating conditions, tailor-made to fit *your* equipment. You get the savings in cost made possible by intensive specialization and modern production tooling. And you get the full benefit of over sixty years' experience in designing specialized metallic gaskets for industry's most complex sealing requirements.

Typical styles of Johns-Manville Goetze Gaskets that have been made to order for high pressure piping service are shown above. The flare type gasket with bellows action and the solid flare type are particularly suited for pressures above 5000 psi; the profile and V-Tite gaskets are generally used for lower pressures. Each of these is fabricated to extremely close tolerances. Other styles can be made to any desired cross section to meet your individual requirements.

For more information about Johns-Manville Goetze Gaskets, write for your copy of Catalog PK-35A. Or send us your drawing or template for an immediate quotation. Address: Johns-Manville, Box 60, New York 16, N. Y.

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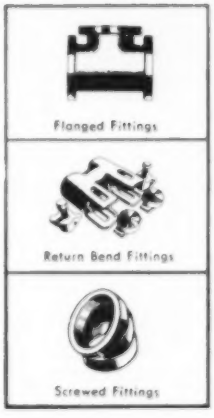
MANUFACTURED TO THE SAME HIGH STANDARDS AS BEAIRD CAST STEEL FITTINGS.

Like Beaird cast steel fittings, Beaird flanges are designed and manufactured for easy installation and minimum maintenance. Full machining of all surfaces; correct flange circumferences; true outside diameter at welding necks; accurate spacing of bolt holes — these speed installation and assure alignment of bores. Gasket replacement is reduced by backfacing flanges, permitting bolts to be tightened evenly, and holding gasket firmly against phonographic grooves of flange faces.

Throughout the United States and in several foreign countries you will find Beaird flanged fittings which have been in service ten to twenty years. Their exceptionally high quality and superior appearance have made Beaird fittings the choice of major petroleum and chemical companies.



Beaird cast steel flanges are made in sizes from 16" O.D. to 63" O.D. They conform to ASTM A216-WCA and ASA B16e,1939.

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Fittings That Fit

A Logical Way to **CURE** Salt-water **CORROSION TROUBLES**

70-30 CUPRO-NICKEL TUBING keeps heat-transfer capacity *up* by keeping corrosion *down*. TIDE WATER ASSOCIATED OIL COMPANY, Bayonne, N. J., utilizes large quantities of this alloy in the form of AMERICAN BRASS COMPANY'S Anaconda Super Nickel 702 tubes. This tubing gives TIDE WATER excellent service in heat exchangers subject to the highly corrosive salt water from the Bayonne Harbor as coolant.

Here's how TIDE WATER ASSOCIATED OIL COMPANY uses the cure . . .

Existing tubes in the majority of exchangers cooled by salt water are being replaced with 70-30 cupro-nickel alloy tubing.

During World War II cupro-nickel condenser tubes were reserved exclusively for naval vessels and tankers, but in 1947 TIDE WATER began to make sizeable replacements . . . using large quantities of Anaconda Super Nickel 702 tubing produced by THE AMERICAN BRASS COMPANY, Waterbury, Conn.

Thin walls of this strong tough alloy resist corrosive and erosive attacks from various cooling media, including polluted, silt-laden waters of harbors and estuaries.

Along with ability to withstand a wide variety of corrosive agents, the 70-30 cupro-nickel tubing provides outstanding resistance to pitting and stress corrosion cracking. Moreover, with cupro-nickel, there is no danger of dezincification.

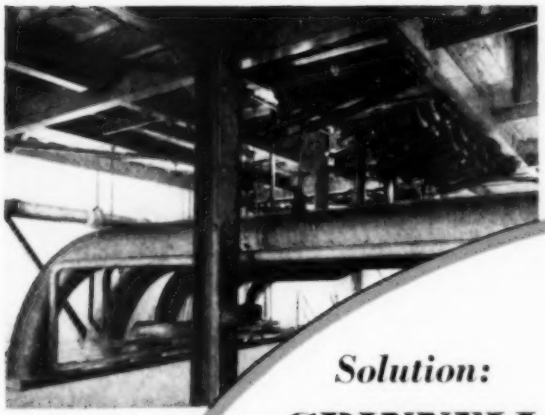
Wherever heat-transfer capacity is a factor . . . where wall thickness allows but little tolerance for effects of corrosion and erosion . . . specify 70-30 cupro-nickel tubes. They eliminate those hidden taxes on profits represented by maintenance and replacement expense, loss of heat transfer capacity and interruptions of operation resulting from corrosion.

Cupro-nickel is produced in tubing, rod, strip, wire and sheet, and also in cast form. We shall be glad to give you additional information about these versatile alloys and help you select the one best suited to your requirements. Write us today.

At the present time, nickel is available for end uses in defense and defense supporting industries. The remainder of the supply is available for some civilian applications and governmental stockpiling.

INCO

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.



Main steam piping at Salem Harbor Station of New England Power, 1000° F and 1450 psi, supported by Grinnell Constant Support Hangers.

Problem:

PIPING THAT GROWS...

Solution:

GRINNELL ENGINEERED HANGERS

Eight . . . nine . . . ten inches of thermal deflection! That's not a bit uncommon in today's high temperature, high pressure systems. Very hard-to-come-by, though, is the skill necessary for dealing successfully with suspension problems resulting from "*piping that grows*" . . .

Large manufacturing facilities, expert technicians, and a lot of down-to-earth practical knowledge are needed.

Grinnell is America's No. 1 supplier of pipe hangers and supports, because Grinnell combines modern manufacturing with expert background knowledge gained during a century of piping specialization. Grinnell has developed hangers and supports for *every* piping need, from the simplest to the most complex. Grinnell, and Grinnell alone, can offer these advantages:

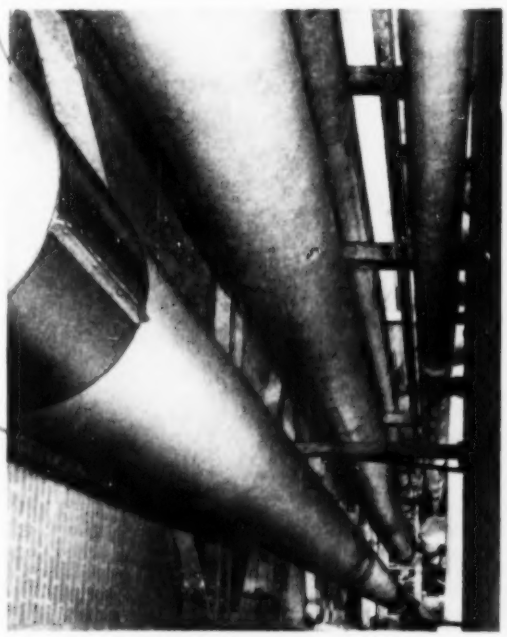
- Complete "start-to-finish" production facilities—including research, design, manufacturing, engineering and field service.
- Practical experience in every type of piping gained during the past 100 years.
- Coast to coast distribution—enabling "out of stock" purchases, anywhere.

Grinnell is always ready to cooperate with engineers and architects in the preparation of pipe suspension specifications. Call Grinnell for pipe hangers and supports.

GRINNELL MODEL L CONSTANT SUPPORTS maintain full safety factor in high temperature, high pressure systems. 3 physical structures accommodate maximum travel requirement of 2½, 5 and 10 inches; 16 sizes collectively cover numerous load ranges between 141 and 19,530 lbs.

GRINNELL PRE-ENGINEERED SPRING HANGERS — maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes. 16 sizes available from stock — load range from 74 lbs. to 9000 lbs.

GRINNELL VIBRATION CONTROL AND SWAY BRACES — dampen vibration, oppose pipe sway and absorb shock. 3 sizes give full deflection forces from 200 to 1800 lbs.; have initial precompressed spring forces from 50 to 450 lbs. respectively.



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pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
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How would YOU solve these 2 problems?

1. IN SOFTBALL MANUFACTURE the most troublesome problem was to obtain absolute uniformity in the kapok cores. These determined hardness, density and shape of the finished balls. H. Harwood & Sons, Inc., of Natick, Mass. solved this problem by molding the cores under hydraulic pressure at closely controlled high temperature. Two inexpensive THERMOSWITCH units per mold provide the needed temperature control at low cost.

2. TAKING THE STRETCH and shrink out of Nylon fish line posed a big problem. It can only be done under high heat. One manufacturer was quoted $18,000 for complicated control equipment. Instead — and very successfully — he stretches the line in a heated die, temperature-controlled by a Fenwal THERMOSWITCH. Cost, less than $25!

3. THIS IS IT — the Fenwal THERMOSWITCH control is simple — compact shell contracts or expands *instantly* with temperature changes, opening or closing electrical contacts. Adjustable and highly resistant to shock and vibration. Fenwal THERMOSWITCH units are solving temperature control problems and improving production throughout all industry.

4. SEND FOR THIS NEW CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write **Fenwal Incorporated, 102 Pleasant Street, Ashland, Massachusetts.**

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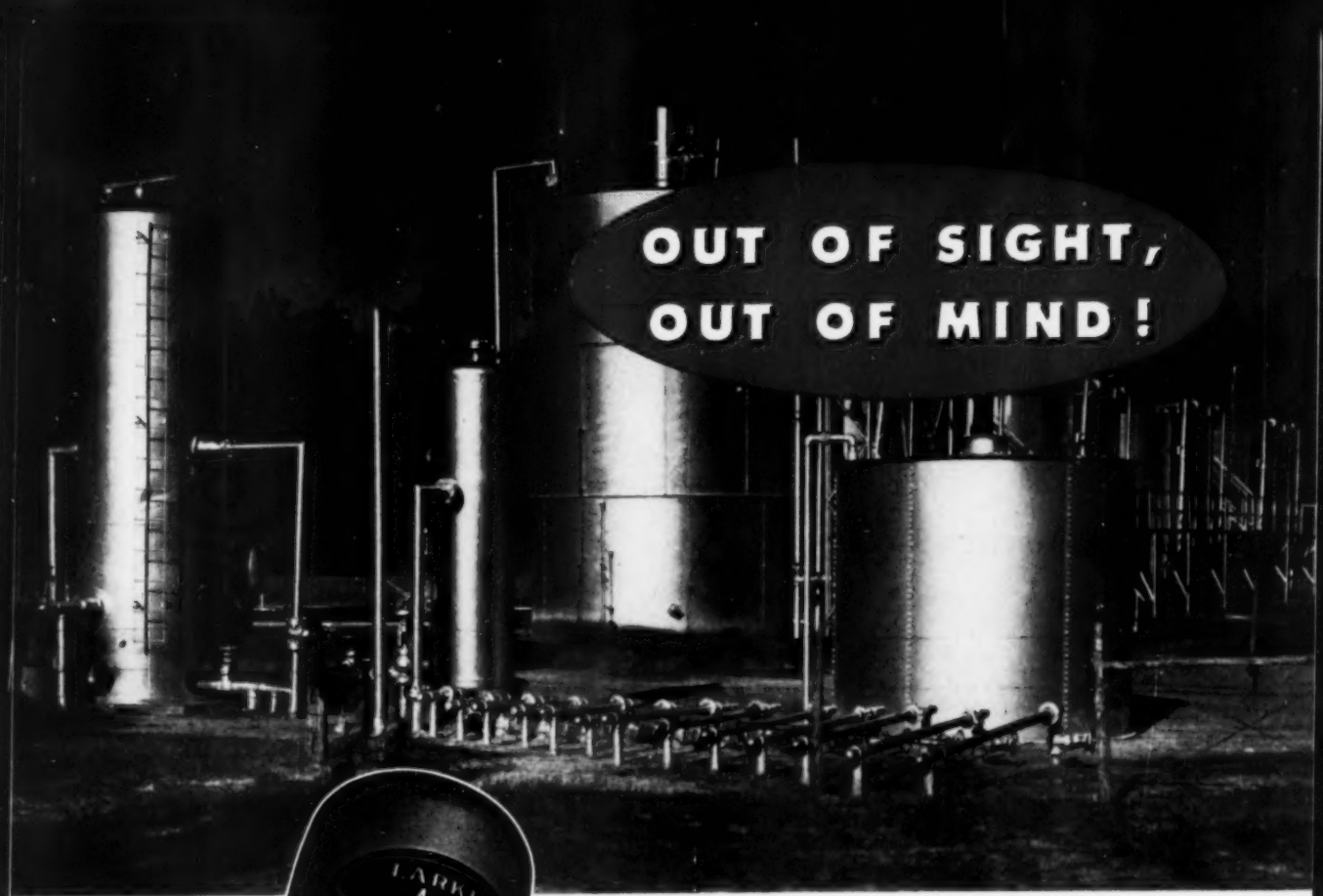
THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE . . . *but only to heat*



● In installations like these, often more swage nipples and bull plugs are used underground than above. When Larkin fittings are specified, they can be buried and forgotten because they are well protected against corrosion and have a generous safety factor. Thousands have given satisfactory service for years in underground hook ups.

Larkin Swage Nipples and Bull Plugs are Zincoted inside and out to protect against corrosion; they are of seamless and weldless construction and made of quality steel. They have square faced ends and accurate threads, with a bevel for easy starting.

Underground or above, wherever swage nipples and bull plugs are needed, your best buy is Larkin. You'll find every size and style you need ". . . Through Your Supply Store."

LARKIN
...Through Your Supply Store

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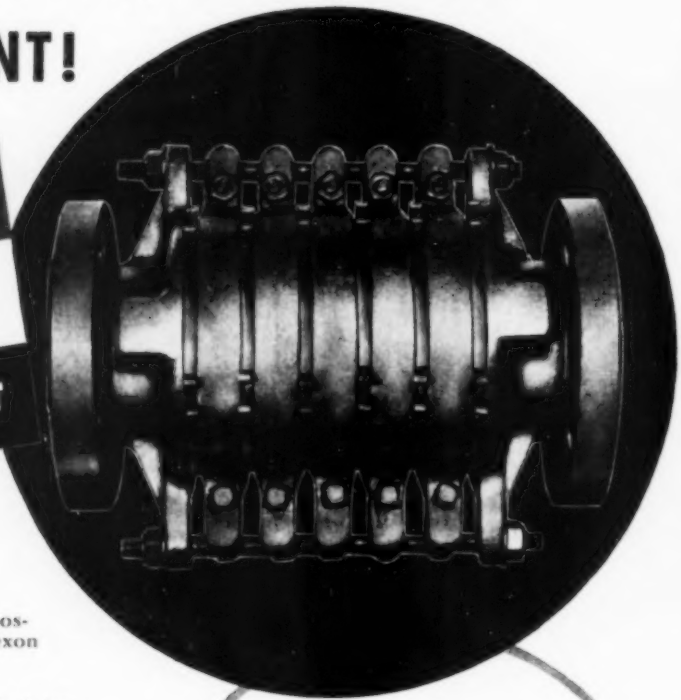
Now you can have GREATER PIPE LINE MOTION CONTROL IN A MORE COMPACT, LESS COSTLY EXPANSION JOINT!

THE NEW

FLEXON

EXPANSION JOINT



Continuing research and development at Flexonics Corporation have now made it possible to offer design improvements in Flexon Expansion Joints that provide three basic advantages:

1. The face-to-face (over-all) dimension of a joint to handle a given amount of expansion has been reduced.
2. The reduction in size results in a lower expansion joint cost to handle a given amount of motion.
3. Exhaustive tests prove that these joints provide a maximum of motion commensurate with optimum life.

Coupled with such accepted advantages as compactness, ease of installation and freedom from maintenance, these additional advantages make Flexon Expansion Joints the most satisfactory method of controlling pipe line motion for the majority of installations.

Complete specifications are given in the new Flexon Expansion Joint Bulletin. Check this data before you select or specify expansion joints for your plant. Write for your copy, today.

THREE TYPES AVAILABLE

FREE FLEXING—Available in sizes from 3" through 48" I.D. in copper or stainless steel. Suitable for pressures to 30 psi, temperatures from minus 100°F. to 800°F.

CONTROLLED FLEXING—(Illustrated above) Available in sizes from 3" through 48" I.D. in copper or stainless steel. Suitable for pressures to 300 psi, temperatures from minus 100°F. to 800°F.

FLEXONIFLEX—Integral ring type. Available in sizes from ½" pipe through 6" pipe. Suitable for pressures to 5500 psi, temperatures from minus 400°F. to 1600°F.

Flexonics *Corporation* **EXPANSION JOINT DIVISION**

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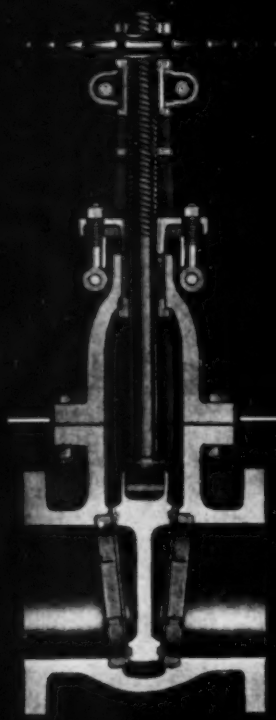
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario



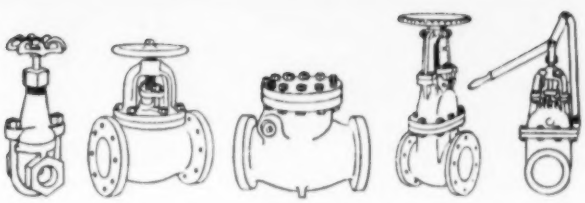
IRON

COMPLETE LINES OF IRON VALVES AND PIPE FITTINGS are manufactured by Walworth in a variety of types, pressure ratings, sizes, and patterns for general industrial use.

Walworth also manufactures complete lines of valves (including Lubricated Plug Valves), and pipe fittings made of steel, bronze, and special alloys.

These valves and pipe fittings, plus Walworth-made pipe wrenches total approximately 50,000 items and are sold through distributors in principal centers throughout the world.

Walworth engineers will be glad to help you with your problems. For further information call your local distributor, nearest Walworth sales office, or write to Walworth Company, General Offices, 60 East 42nd Street, New York 17, New York.



Iron valves in gate, globe, angle, check, and lubricated plug types are manufactured by Walworth. Illustrated is a sectional view of a Walworth No. 726F Standard Iron Body, Bronze Mounted, Wedge Gate Valve with flanged ends. This line of valves is available in sizes 2 to 30 inches. Similar valves of All-Iron type are also available.

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valves . . . pipe fittings . . . pipe wrenches

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*(a patented alloy)**

Long-lasting because there's enough antimony to resist dezincification.

Long-lasting because the antimony does not affect the grain structure of the metal—won't weaken the tube.

Long-lasting because years of tests and actual use have proved that the right amount of antimony increases the life of the tube.

So before you replace heat exchanger tubes . . . ask about Chase Antimonial Admiralty.

CHASE WAREHOUSE STOCKS:
NEW YORK, BALTIMORE, NEW ORLEANS, LOS ANGELES, also carried by—
Vinson Supply Co., Tulsa;
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FREE CHASE BOOK discusses corrosion problems and selection of proper alloy for condenser and heat exchanger tubes.

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WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

• *The Nation's Headquarters for Brass & Copper*

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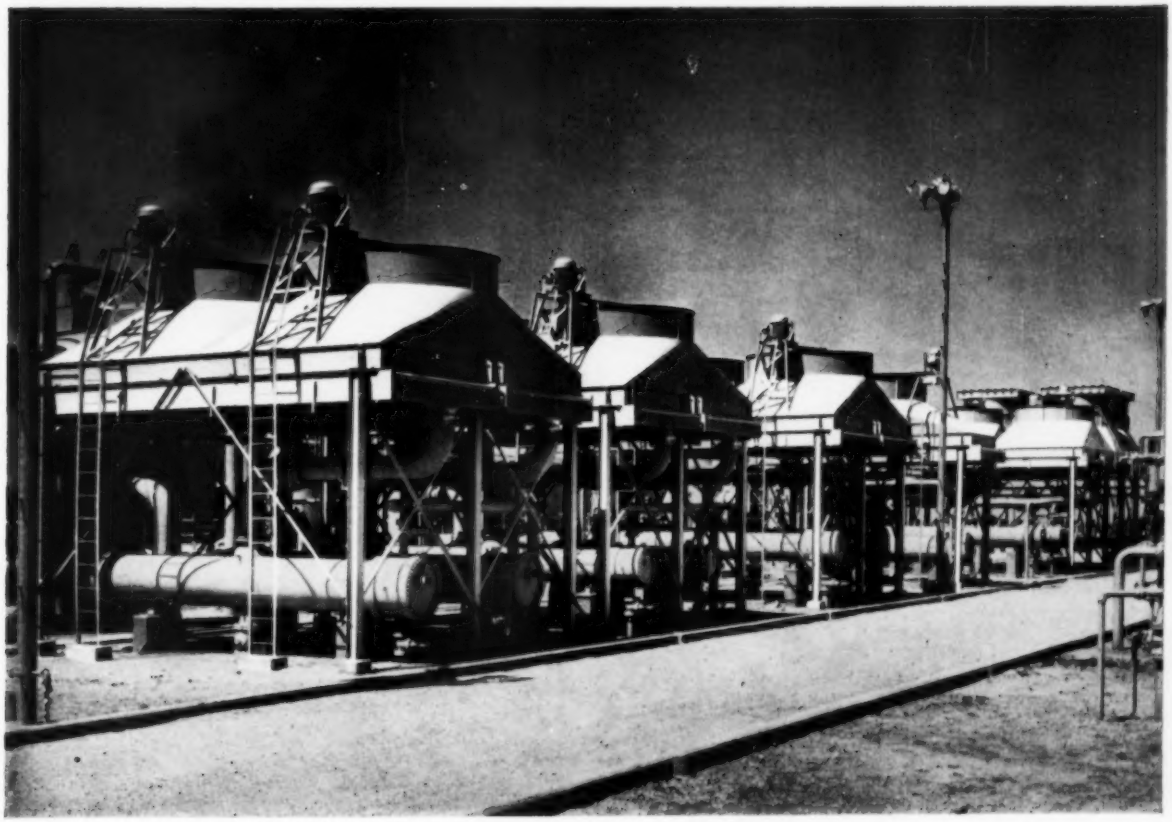
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston†	Newark	Rochester†	(†sales office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	



HUDSON *Solo-aire* EXCHANGERS

Bulletins on HUDSON TOP PERFORMANCE cooling equipment mailed upon request.

At the Diamond M-Sharon Ridge gas processing plant in Scurry County, West Texas, most of the heat from gas compressed in three stages is dissipated directly to the air in the SOLO-AIRE units shown above. Other SOLO-AIRE units are employed in this plant for oil cooling, acid gas condensing, still overhead condensing, propane and butane condensing, and jacket water cooling. In this and many other plants in water-scarce West Texas, Hudson SOLO-AIRE units have established their reputation for dependable, trouble-free operation.

HUDSON

ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

Manufactured under one or more of the following U. S. Patents: 2,508,517 — 2,508,518 — 2,562,785 and other patents pending.

HUDSON Top Performance COOLING EQUIPMENT

For more than two decades HUDSON personnel have developed equipment for heat recovery and heat dissipation. Present day HUDSON cooling equipment has been evolved through the years by constant improvements in design and fabrication.

COOLING TOWERS

Beauty and utility have been successfully combined in the HUDSON "TP" design. These Top Performance cooling towers embodying new but proven advancements in water cooling design, result in lower installation and operating costs for a given guaranteed performance.

SOLO-AIRE EXCHANGERS

HUDSON Solo-aire exchangers for jacket water cooling, gas cooling, steam condensing and hydrocarbon vapor condensing have found wide use, particularly where suitable cooling water is impossible or expensive to obtain. Even where adequate quality and quantity of water is available there are conditions under which these units have marked advantages over alternative cooling methods. Designs are available for pressures up to 5,000 pounds per square inch.

COMBIN-AIRE UNITS

By combining in one structure Solo-aire units with a cooling tower, HUDSON originated the Combin-aire unit. In hot weather, air before use in the Solo-aire units, is contacted with water to reduce both air and water temperature. In cold weather, water use is unnecessary. This device makes possible the use of air for low temperature cooling, allows use of untreated water, minimizes water consumption, and results in capital and operating savings.

AUTO-VARIABLE PITCH FANS

The latest in a long list of Hudson innovations. The auto-variable pitch fan controls cooler outlet temperature through automatic change in fan blade pitch, which in turn changes air volume across cooler tubes. Outlet temperature is closely controlled, and in a typical case horsepower consumption over the year is reduced seventy percent as compared with fixed pitch fan operation.

ATMOSPHERIC SECTIONS

These units are for use where water serves as cooling medium. They may be mounted vertically or horizontally, under cooling tower or submerged in water.

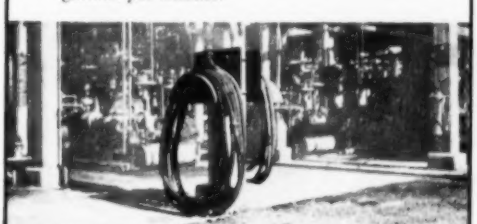
UNDIVIDED RESPONSIBILITY—***Complete integration of facilities in selection, design and manufacture of cooling towers, water cooled atmospheric sections, and air cooled exchangers results in cooling systems of minimum first cost, minimum operating cost, and in undivided responsibility.***

HUDSON
ENGINEERING CORPORATION
FAIRVIEW STATION • HOUSTON, TEXAS

How many chores does U. S. Rubber's hose perform?

Loading Bunker oil, Ethyl gasoline and regular gasoline through U. S. Rubber's Amazon Dock Hose.

Pumper trailer with U.S. Rubber's neoprene-covered fire hose. Capacity is 500 gallons per minute.



U. S. Matchless® Steam Hose on a typical hose rack in a refinery.

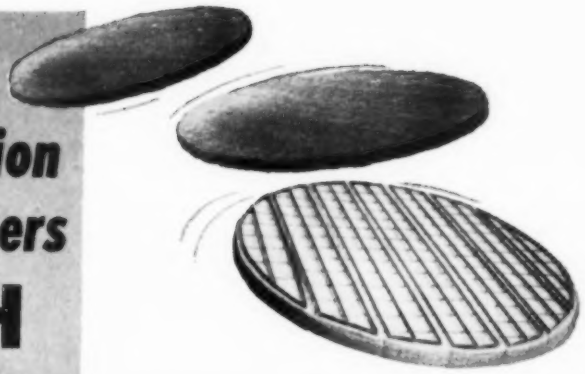
Here are but a few examples of the many installations where "U. S." hose is working daily on the docks and throughout the entire refinery. You'll find it transporting oil, gasoline, washing down, thawing out, dissipating volatile gases. You'll find it ready to fight fires and perform many other special jobs... in fact, there is a "U. S." hose for every refinery need. Refinery men know that United States Rubber Company hose always exceeds the standards of safety boards and protective statutes. For complete hose information, write to address below.

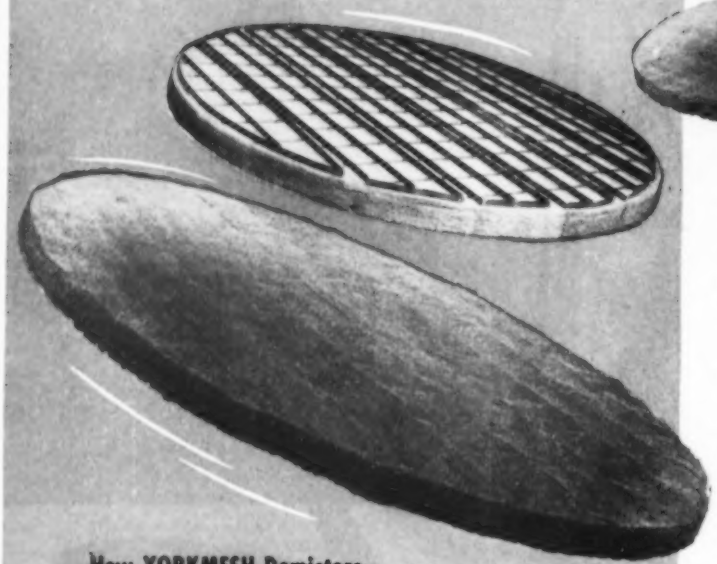
PRODUCT OF U.S. RUBBER SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Reach New Highs in Quality and Production from your Cat Crackers with YORKMESH Demisters...





YORKMESH Demisters (entrainment separators—mist eliminators) are answering Petroleum Engineers demands the world over for simple means of improving the performance and increasing the throughput capacities of catalytic cracking units.

Yorkmesh Demisters in Vacuum Towers remove substantially all liquid entrainment even at increased vapor velocities—the gas oil then produced has lower carbon content and considerably reduced metals content—the reduced metals content accounts for continued high catalyst activity. The net result is more gasoline of higher octane rating.

Yorkmesh Demisters are used equally successfully to improve the performance of gas absorbers, scrubbers, separators, evaporators, knock-out drums, etc.

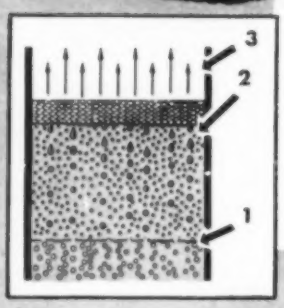
Easily installed in existing or new equipment.—Materials: Types 430, 304, 316 stainless, monel, carbon steel, etc.—Prompt shipment.

How YORKMESH Demisters work inside Vacuum Towers

1 *Vapor disengaging from liquid creates fine liquid droplets which are carried as entrainment by the vapor stream.*

2 *The liquid droplets impinge on the fine wire surfaces of YORKMESH, and are coalesced into large drops which run down and fall off the YORKMESH.*

3 *The vapor is now dry. It has been entirely freed from entrained liquid. Thus a clean gas-oil goes to the catalytic cracker.*



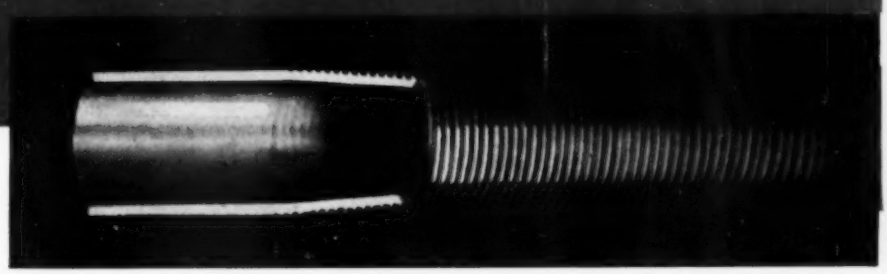
Write for new Catalog 13 for complete information and engineering data on YORKMESH Demisters.

OTTO H. YORK Co., INC.

67 Glenwood Place, East Orange, N. J.

Come to Wolverine

for FINNED CONDENSER TUBES •



THAT GIVE YOU LONGER LIFE AT LOW-COST OPERATION

Illustrated above is a cut-away section of the unique Wolverine Trufin* showing the integral fin construction.

Note that the fins are formed from the wall of the tube. They are one and the same metal. Because of this all-one-piece construction, the fins will withstand vibration and sudden temperature changes.

The increased surface area provided by the smooth, clean surface of the fins allows liquids and gases to flow freely permitting the maximum in heat transfer efficiency.

Trufin is available in a wide range of sizes and alloys to meet your particular corrosion problems.

*REG. U. S. PAT. OFF.

If you plan to attend the National Association of Corrosion Engineers Exposition, we'll be glad to have you visit our Booth 115-116.

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

WOLVERINE TUBE DIVISION
of CALUMET & HECLA, INC.
Manufacturers of Tubing Exclusively
1431 CENTRAL AVENUE • DETROIT 9, MICHIGAN
ESTABLISHED 1916
Plants in Detroit, Mich. & Decatur, Ala. *Sales offices in Principal Cities*

Export Department, 13 E. 40th St., New York 16, N. Y.

ORBIT VALVES®

HERE'S WHY ORBIT VALVES ARE ESPECIALLY SUITED FOR LPG SERVICE

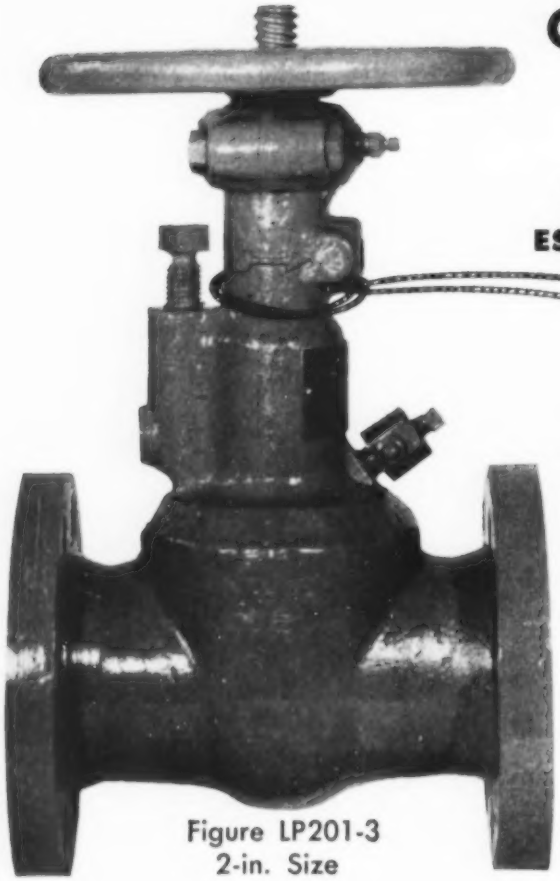


Figure LP201-3
2-in. Size

1. Forged Steel Body and Bonnet — Welded together to insure against vapor leaks.

2. Plastic Stem Packing that is adjustable. Stem Packing Chamber is backed up by a supply of auxiliary packing as extra insurance against leakage along the stem. Can be repacked under pressure in either open or closed position.

3. A Seating Principle that is both resilient and friction free, requires no lubricant to effect a seal or to wash out and contaminate the fluid being handled.

4. Rising Stem. Operator can tell at a glance whether valve is in open or closed position — guessing can be costly.

ORBIT Forged Steel LPG VALVES are available in sizes: 1″, 1½″, 2″, 2½″, 3″ and 4″, ASA Ratings beginning at 150 lb., to and including 2500 lb. with Flanged and Screw Ends.

Maximum Rated Working Temperature of these valves is 250° Fahrenheit.

ORBIT Forged Steel VALVES are carried in stock by many supply stores.

® There is only <u>one</u> ORBIT

ORBIT VALVE COMPANY

P. O. BOX 699 — TULSA, OKLA.

BRANCHES

HOUSTON, TEXAS
407 Velasco
(Servicing the Gulf Coast)

ODESSA, TEXAS
402 West County Road
(Serving West Texas)

CASPER, WYOMING
1323 East "C" Street
(Serving the Rocky Mountain States and Canada)

[Letters]

Is This a Record Run?

Dear Sir:

We would like to know the established record for length of operation (in days) for a topping unit on the West Coast. One of our topping units has been on stream since August 9, 1951, running approximately 4000 barrels per day, from then to date. We are running a crude oil charge blended from typical west stocks (including Brea, Cuyama, Rosecrans, Signal Hill, Seal Beach and Wilmington crudes).

Raymond R. Rich, Chief Chemist
Sunset Oil Company
Los Angeles.

Editor's Note: *We haven't been able to contact any one with a better record. If any of our readers know of a longer run, please let us know. Counting on our fingers it looks like 18 months is a mighty enviable record.*

Process Issue

Dear Sir:

The excellent work which appeared in the PETROLEUM REFINER in September, 1952 is of considerable importance to our readers. This section was entitled the "1952 Process Section." We would like your permission to publish an enlarged resume of this section, including the corresponding flowsheets, in our review, "Combustible."

V. Gómez Aranda, Director,
Superior Council of
Scientific Investigations,
Combustibles Institute,
Zarogoza, Spain.

Thanks from Chile

Dear Sir:

I want to thank you for all that you have done for me and my school. This includes your notice in your September issue that we need back numbers of your PETROLEUM REFINER. This notice has already partly done its service because we have heard from a number of people in the U. S.

W. Dreifuss, Instructor,
Instituto de Quimica Industrial,
Concepcion, Chile.

"What Prompts Progress"

Dear Sir:

I want to compliment you on your article "What Prompts Progress." Your reasoning is about the best along this line that I have run across. Sure do hope it hits "home" with some of the recalcitrants.

Frank A. Anderson, Chairman,
Department of Chemistry and
Chemical Engineering,
The University of Mississippi,
University, Miss.

Dear Sir:

"As you doubtless know there have been a number of articles published in various trade journals on our plant facilities, designs and developments which were prepared either by our engineers or representatives of the publications themselves. We have always exchanged information freely with other refiners and feel that by so doing, and by contributing information on our own developments, that the whole industry benefits thereby . . ."

Lee Haugen, vice president,
Cities Service Oil Company

CENTRIFUGAL BLOWERS AND EXHAUSTERS
single and multi-stage units, in capacities from 2,000 cfm to 100,000 cfm or higher, at maximum practical pressures.
Rotary Positive Gas Pumps
5 cfm to 50,000 cfm.
Rotary Positive Blowers and Exhausters
5 cfm to 50,000 cfm.
Positive Displacement Meters
4,000 cfh to 1,000,000 cfh.
Cycloidal Vacuum Pumps
500 cfm to 13,000 cfm.
Inert Gas Generators
1,000 cfh to 35,000 cfh.

WE *Specialize* IN YOUR PROBLEMS OF MOVING GAS OR AIR!

You may need to move a thimbleful of gas . . . or create a cyclone of whirling air. Whatever your problem, we've probably met something close to it, in experience of almost a century of building such equipment.

Another reason why we know so much about this job is that it's all we do. Our customers range from the "giants of industry" to the neighborhood plant, both of whose production depends upon continuous, reliable, economical performance of air and gas handling units. Because we build the exclusive *dual-ability* line of Rotary Positive and Centrifugal Units, in a wide range of sizes, we offer a *dual choice* which permits completely unbiased recommendations.

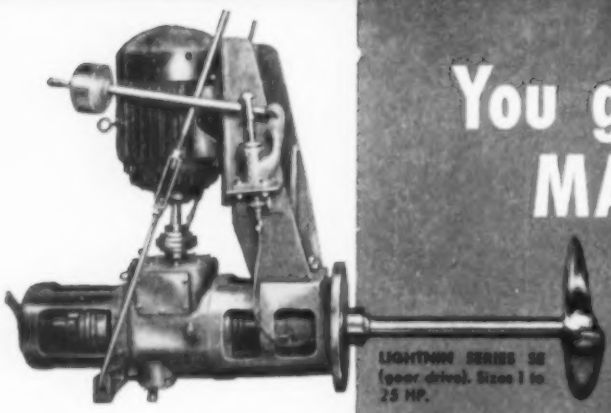
So—if you have a problem today—or anticipate one a year or five years from now, we suggest you call upon the facilities of R-C Specialists. Write for bulletins on any specific equipment.

ROOTS-CONNERSVILLE
Exclusive Specialists in Handling Gas and Air
BLOWER BUILDERS SINCE 1854

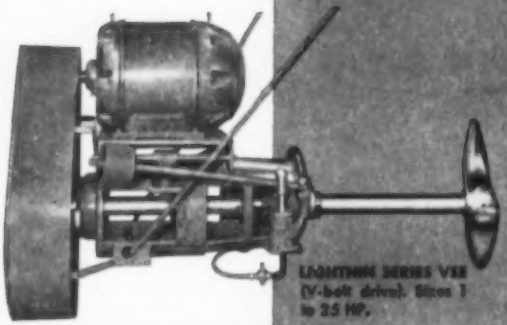
ROOTS-CONNERSVILLE BLOWER
A DIVISION OF DRESSER INDUSTRIES, INC • 253 Crescent Ave. • Connersville, Indiana

You get ROCK-BOTTOM MAINTENANCE COST

with these 2 new side entering mixers

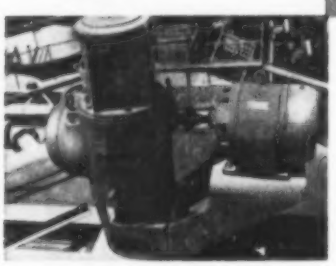


LIGHTNIN SERIES SE (gear drive). Sizes 1 to 25 HP.



LIGHTNIN SERIES VSE (V-belt drive). Sizes 1 to 25 HP.

No wrenches needed to operate new liquid shutoff seal



TOP ENTERING turbine and paddle type mixers for open or closed tanks. Sizes 1 to 500 HP.

LIGHTNIN PORTABLE MIXERS . . . used everywhere for hundreds of fluid mixing jobs. Thirty models to choose from. Sizes ⅛ to 3 HP.

If you've ever tried to repack a mixer stuffing box with a full head of liquid in the tank, you'll appreciate these new LIGHTNIN Side Entering Mixers. And so will your maintenance crew!

With either type, shutting off the mixer from the tank is about as easy as closing a valve. The operator loosens one set screw. Then he grabs the easy-to-get-at handles on the outboard bearing member, and gives them a few turns. No wrenches!

This withdraws the mixer shaft just enough to compress a Teflon gasket on the mixer end cap, within the tank —creating a positive, pressure-tight seal that makes repacking a quick, simple job.

Your choice of stuffing boxes or mechanical seals

With these new mixers, you get the same full choice of stuffing boxes as always, to best meet your conditions.

Or, if you prefer to operate with mechanical seals, you have a wide choice of single or double seals that *entirely eliminate* repacking.

For extra protection, the mechanical seal is quickly convertible to a packed stuffing box at any time. This safeguards you in case of seal failure. It permits the mixer to keep operating until the seal can be replaced at your convenience.

Specify the new LIGHTNIN Mixers for gasoline blending, lube oil blending, sediment control—and wherever there's a *big* mixing job that must be done *right*. Call your MIXCO representative today, or write us for details.

"Lightnin® Mixers"

GET THESE HELPFUL LIGHTNIN CATALOGS

This library of mixing information is yours for the asking. Catalogs contain helpful data on impeller selection; sizing; best type of vessel; valuable installation and operating hints; complete description of LIGHTNIN Mixers.

MIXCO fluid mixing specialists

MIXING EQUIPMENT Co., Inc.

164 Mt. Read Blvd., Rochester 11, N. Y.

In Canada: William & J. G. Greey, Ltd., Toronto 1, Ont.

- ☐ DH-50 Laboratory Mixers
- ☐ B-75 Portable Mixers (electric and air driven)
- ☐ B-102 Top Entering Mixers (turbine and paddle types)
- ☐ B-103 Top Entering Mixers (propeller type)
- ☐ B-104 Side Entering Mixers
- ☐ B-106 Condensed Catalog (complete line)
- ☐ B-107 Mixing Data Sheet

Please send me the catalogs checked at left.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

PETROLEUM REFINER

The LOOK BOX

Via Market Research Alone?

WITH THE complexity of our business organizations, department heads in the routine of their jobs often get derailed from the goal of their efforts—maximizing return on investment. Often a company will set as its immediate goal the largest plant in town, or the largest truck fleet, or the largest sales force; and though these goals once set are usually attained, return on investment has not been maximized.

Further, when the major goal is sought after, the usual practice is as follows: the standard functional departments each work within the framework of uncontrollable factors to achieve what, to them, is the absolute maximum of efficiency. That having been done, the final best developments of each of these departments are put together as so many factors producing, in the end, a return on investment which, because it is a resultant, is almost an accidental figure.

Looking at the goal in its proper perspective, Robert H. Collacott, assistant to the chairman, The Standard Oil Company (Ohio), called to mind in a recent speech that the Twentieth Century Fund study before the war showed that 59 cents of the consumer's commodity dollar went for distribution, and only the balance for materials and manufacturing costs. He pointed out that it is probably an even greater percentage now as the production methods have tended to outstrip those economies developed in marketing and distribution. He made the point that there is an early mathematical limit to the process by which even *great* production savings can have much economic value to society if they carry with them even slight increases in marketing and distribution costs.

And is the answer so simple that the only course is research within the market function alone? No, says Mr. Callacott, research of an inter-departmental nature is also necessary, because any research project depends for its ultimate value upon the combined enthusiasm and support of the people involved. Any research problem must have satisfactory liaison with the operating people and the matter can never be settled unless the line manager acts as his own research director. This approach does raise problems with no ready answer since it involves the temperaments, backgrounds and interests of many "sovereign" departments. However, it could be materially lessened by the provision that affected departments could do their own factual development. Maximizing return on investment will be accomplished only by a systematic examination of *all* the factors bearing on the end results.

What Price Enthusiasm?

WHEREVER BOSSES gather, the conversation is apt to turn to "what is the most desirable quality in an employe?" We say the most important quality of all can't be measured by the employment interviewer. That quality is enthusiasm.

Take the case of engineers. Most interviewers look first at his scholastic record. Let's say that the agility of his mind is well confirmed with a straight-A record. Next we turn to his personality. He's a nice guy, dresses neatly, has plenty of poise. Heck, he has everything we need so we sign him up.

With high hopes and fond expectations, we assign him a job. Two weeks later, we have him on the carpet because the job isn't done. What's wrong? We know he has the brains. He gets along well with the other men, but *he isn't getting the job done.* He just doesn't have that indefeatable, won't-give-up spark called *enthusiasm.*

What can we do? Intelligent, inspirational supervision is the best medicine. Employes will always reflect the aggressiveness of management. If that fails, let him go—the best brains in the world aren't worth five cents if they aren't being used.

Enthusiasm makes the engineer seek out the problem. Enthusiasm guarantees that he will get the answer.

What's Making Canada Tick

CANADA is enjoying great prosperity—some even call it a "boom"—and those who have studied the factors behind it come up with two big "why's":

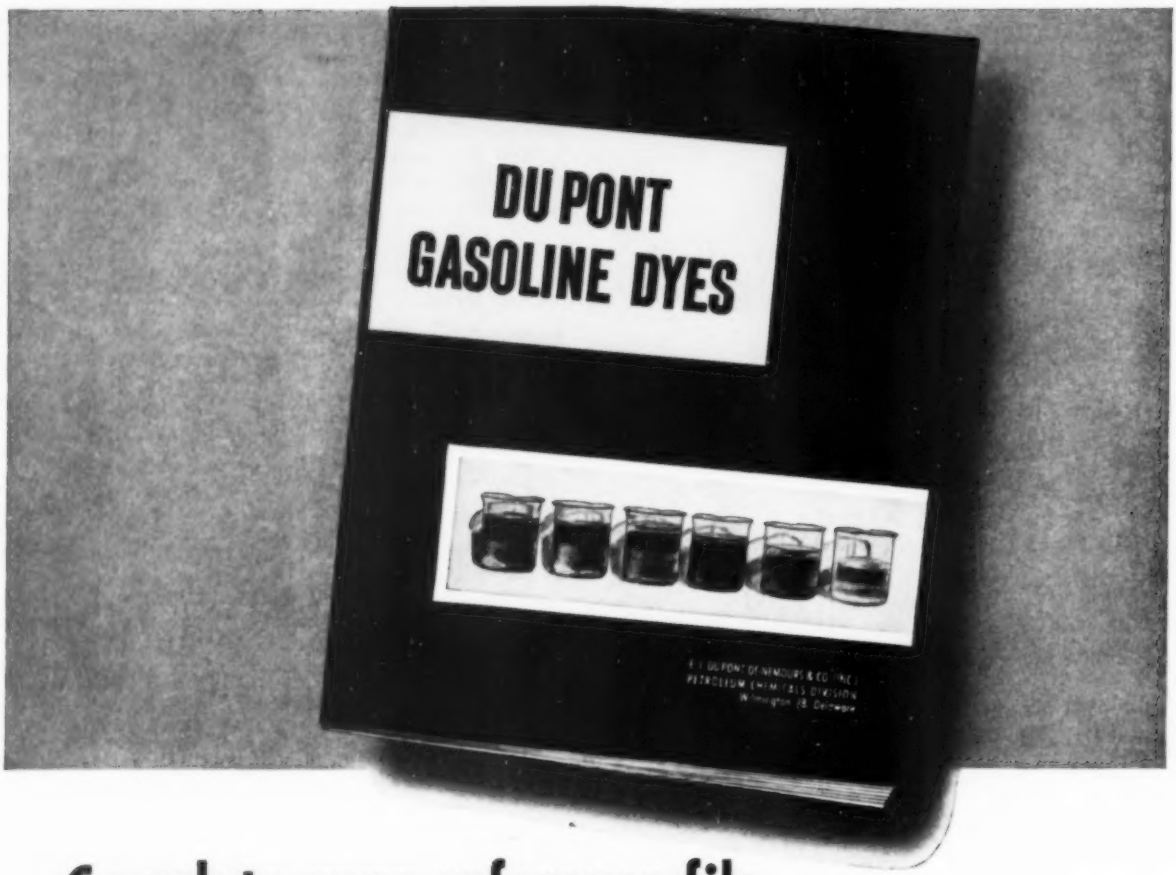
- The hunger for raw materials in the U. S.
- Corporation taxes are lower than in the U. S. and there's no tax whatever on capital gains.

"So you want a profit?" Canada asks. "Then take your risk. You may lose your shirt, or become wealthy beyond your dreams. If you win, more power to you. We have one interest: the development of the country. We provide the opportunity. The private enterprise system provides the incentive!"

This is the finding of the January issue of *The York Report,* published by York Engineering & Construction Company, Pittsburgh, which continues:

"Profits from sales of capital assets belong to the owner 100 percent. Canada demands no cut from the fruits of the venture, whether in the development of a tract of land, the growth of a small business or in gainful ownership of common stock. Global political implications of all this have escaped the attention they merit."

"Contrast the results with those in other lands



Complete your reference file on gasoline dyes with this helpful booklet

The use of gasoline dyes has always presented a number of handling and addition problems. Now, all the information a refiner needs to have about coloring gasoline is available in one compact booklet.

The lastest methods of dyeing gasoline are fully discussed. It explains in detail the dry dye eductor system as well as the various other methods of addition by dye pot.

The booklet also gives complete information on all Du Pont gasoline dyes—including solubility charts and spectrophotometer curves. And it contains much helpful information on handling dyes; such as how to remove dye stains from clothing and equipment plus useful shipping information.

In order to have this booklet on file for ready reference, ask now for a copy of "Du Pont Gasoline Dyes." Address your request to the nearest Du Pont Petroleum Chemicals Division district office.

DU PONT

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Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices: New York, N. Y. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · Los Angeles, Calif.

District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

IN CANADA: Canadian Industries Limited—Toronto, Ont.—Montreal, Que.—Calgary, Alta.

where private enterprise is being strait-jacketed or eliminated entirely by their legislatures or dictatorships."

The United States, in its earlier day, developed this pattern and waxed prosperous. Now Canada is showing us that the same principles are as good today as they were 25 years ago. Would that some of our own political leaders had held to these proven principles rather than taken the path that, history shows, leads but to certain destruction of a nation's economy!

All in One Day's Mail

AS A PRACTICING engineer in the industry, we made highly profitable use of PETROLEUM REFINER as an every day working tool designed to help in doing a better job. But we had no idea of the world-wide effects of the magazine until we started to work here as an editor. Each day brings a fresh and interesting revelation that somehow, some where, we have been able to help someone do a better day's work for themselves and their bosses.

Take today's mail. Here's a letter from a Chinese engineer in Formosa. It contains a compliment for us and a contribution to our "How To Do It" department that may make it possible for someone clear across the world to do his work more efficiently. Here's another from a publication house which is accumulating material for a book on management problems and would like our permission to reprint verbatim several articles we have carried in the past year on this important subject. Then there's this one from a *drydock* company, praising our Instrumentation Issue and requesting a reprint. Now why would a drydock company be interested in instrumentation!

And so on through a pretty big stack of correspondence. It's certainly interesting and always inspires a little sober reflection. A lot of people all over the world depend on PETROLEUM REFINER as their chief source of refinery information. That's a big job for our authors and ourselves.

Nasty Words Leave Bad Taste

WITH A FINAL and ill-begotten sally at the oil industry, Mr. Truman has gone back to Missouri. His final official act was to turn the tidelands over to the Navy Department. And as usual, some undeserved insults were added to the injury.

Mr. Truman said that it is "my firm conviction that it would be the height of folly" for the federal government to "give away" the offshore oil and then buy it back at "*stiff prices.*" The ex-President's public utterances are frequently tactless, often vindictive. We think the latter adjective is most accurate in this case.

First, it is not the prerogative of the executive department of the federal government to "give away" federal properties. So Mr. Truman's decision is without legal foundation; more particularly when it is recalled that considerable doubt exists as to whether the federal government is the owner of the tidelands. The proper disposition of the tidelands was a major issue in the November elections and this country's citizens (who *are* the government) pointed the way quite clearly for future legislative action on the tidelands subject. The voter's hearty endorsement of the candidate who sponsored return of the tidelands to the states left little doubt as to public sentiment.

Secondly, we object strenuously to Truman's reference to buying back the oil at "stiff prices." Certainly no industry known to us can match the record of the oil industry for holding down the prices of their products. We know of no single other major product that the consumer can buy for the same price now that he did before Mr. Truman went in to office!

Hasty deeds and ill-chosen words were the measure of a man who entered his office in deep humility and left it in vindictive wrath over a well-earned defeat at the hands of the voters. Many of us poorly schooled in political chicanery will best remember the gentleman for such difficult to understand deeds as the tidelands order, the offer to "swap" criminal charges for civil charges in the antitrust suit, and others.

For those of us in the oil business, Mr. Eisenhower's assumption of the Presidency is certain to be a welcome change for the better.

Fuel Oil Stocks Piling Up

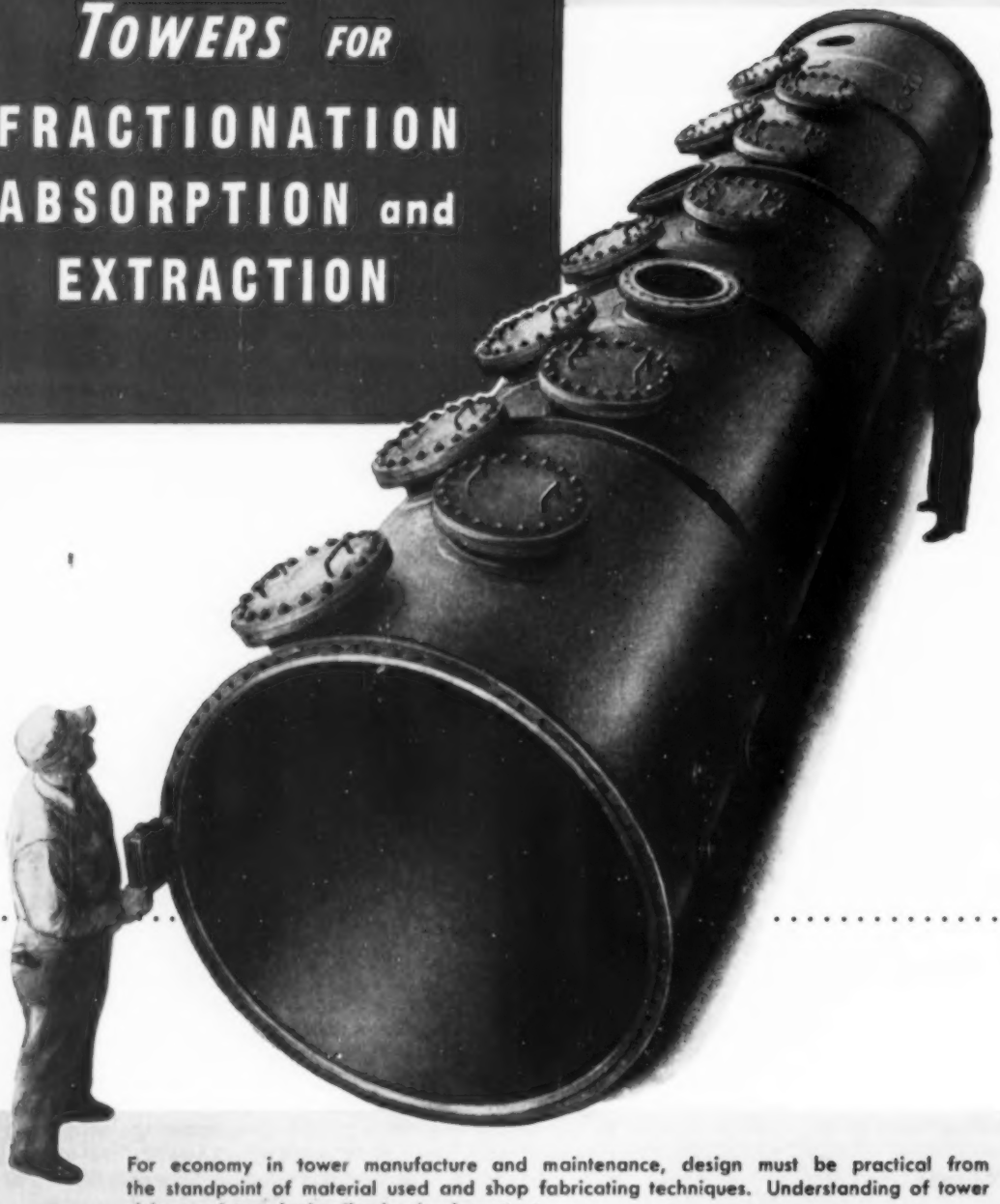
THE HIGH rate at which the nation's refineries have been operating has caused a pile-up of fuel oil stocks in some areas, particularly on the East and West Coasts. Reflecting the residual fuel oil situation on the East Coast is a price cut, the first in some months. Mid-January saw some ease in refinery rates, but the level appeared still too high.

The United States as a whole has about 14 million barrels or almost 17 percent more distillate fuel oil on hand than it did a year ago. And the coastal areas figure prominently in the increase. Almost four million barrels or 19 percent more distillate have accumulated on the East Coast than were in tanks a year before, while the supplying Gulf Coast's were down about two million or 16.4 percent. The greatest gain in accumulations has occurred in California where stocks total over four million barrels or an unhealthy 62 percent more than they did a year ago.

Approximately the same situation exists with the residual fuel oils. East Coast's supply is two million barrels or 19 percent greater and California has over five million barrels or 41 percent more than it had a year ago. Principal region where less residual supplies exist is the Mid-Continent, where many utility companies have intensified demand for this fuel by converting from other types.

In contrast to the fuel oil picture, gasoline stocks are fairly well in balance with year-ago supplies, being only 1.7 percent higher. However, if refineries are continued to be operated at their present pace, stocks of motor fuel could become excessive before the spring's motoring season begins to siphon off supplies.

TOWERS FOR FRACTIONATION ABSORPTION and EXTRACTION



For economy in tower manufacture and maintenance, design must be practical from the standpoint of material used and shop fabricating techniques. Understanding of tower sizing and tray hydraulics is also important.

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The cost of settling the average compensation claim in Texas rose 44 percent to $182.39 from 1948 until 1952.

Why Are Compensation Costs Higher?

Texas employers rally behind legislation which would lower rates by removing abuses in granting awards

Al Reese, Editor
Special Assignments

THE TEXAS refining industry was adding a 34.7 percent compensation insurance rate increase to the cost of its expansion program this month as employers in many state industries rallied behind legislation designed to remove expensive abuses from the method of granting accident awards.

In response to the insurance carriers' argument that the cost of settling the average compensation claim in Texas rose 44 percent during 1948-52 to $182.39, the Texas Board of Insurance Commissioners granted a general increase averaging 17.9 percent. Oil was hard hit, and hit hardest of all was the category of Still Erection or Repair, which will now be assessed at $4.46 on the $100 of payroll, up from $3.31. Percentagewise, this was the most severe increase levied against any segment of the Texas oil industry.

Even the category of oil refining, long alert to good safety practices and enjoying the second lowest compensation insurance rates of all segments of Texas oil activity, was tagged with a 2 percent increase, thus breaking a downward trend which had endured since 1949.

The scarcity of subsequent protests indicated that most industries, oil and otherwise, were resigned to the new rates; but the drilling contractors assembled an argument based on high wages which would apply to the refining industry.

The drilling contractors' rebuttal stemmed from the Board of Insurance Commissioners' Circular Letter No. 239, issued in February, 1952, which raised from $100 to $200 the average weekly payroll unit used for premium computation purposes. At its October hearing the Board took cognizance of an additional exposure to insurance premiums of all Texas industrial payrolls under the $200 ceiling and handed down a 1½ percent allowance all down the line. However, the drilling industry argued that since the ceiling was lifted it has exposed a much greater percentage of its payroll to premium payments than most other industries. Hence, in effect, it is paying the 1½ percent allowance given those industries in the lower wage brackets.

A weekly payroll unit, Table 1, was used to illustrate.

TABLE 1

	$100 Limitation	$200 Limitation
3 Derrickmen	$285.12	$285.12
3 Motormen	$285.12	$285.12
6 Helpers	$537.84	$537.84
3 Drillers	$300.00	$182.32
1 Drilling Sup't	$100.00	$175.00
	$1,508.08	$1,665.40

Additional payroll exposed to premiums in this instance is the difference between $1665.40 and $1508.08, or $157.32, which is a 10.432 percent increase.

"We wish particularly to emphasize," the contractors declared, "that this is a payroll adjustment which in no way involves an exposure of the carriers to any greater hazard of manhours worked."

The carriers advanced other sobering arguments for a higher rate. The Texas Employers' Insurance Association of Dallas, which was created under the Texas Workmen's Compensation Act to insure employers at cost, and which is a heavy insurer of oil field activities, reported that:

In the February, 1948, rates 55.8 percent of the claims reported to the association listed a maximum indem-

nity rate of $25. per week, and by the end of 1951, wages had risen to the point where 80.2 percent of the claimants were entitled to the maximum weekly benefits.

From February, 1948, through February, 1952, average daily wages rose 34 percent. Normally, increasing wage scales have a tendency to reduce loss ratios, but procedures connected with settling indemnity claims in Texas have more than offset this.

In the 1949 calendar year the loss ratio in Texas was 52.4 percent, or 90 percent of the allowable in the rate. In 1950 the loss ratio moved to 63 percent and continued to climb in the following year until it reached 69.6 percent by the end of 1951, which is 20 percent higher than the allowable in the rate.

Mathematical Computation

To the insurance companies, the necessity for the higher premiums is as unarguable as a mathematical formula. Because there is no existing method for recording the accident frequency of all companies in all industries, the payrolls of the insured firms are divided into their losses to arrive at a pure premium. This figure is multiplied by a factor to cover the carriers' expenses. The final sum is reconciled to current and expected conditions and then recommended to the Board of Insurance Commissioners.

Because of the method of adjusting insurance rates with credits or debits according to losses incurred, the net cost to each assured will not necessarily be in proportion to the over-all increase. However, the increase was more than enough to cause Texas employers to take a hard new look at their safety programs and to the procedure for granting compensation awards.

Increases in Texas Compensation Insurance Rates
(Pemiums Computed on Each $100 of Payroll)

	From	To	Percent Increase
Oil or gas geologists or scouts	.35	.42	20.0
Oil or gas lease work	4.31	4.97	15.3
Oil or gas wells—cementing	3.47	3.80	9.5
Oil or gas wells—development	7.80	10.05	28.8
Oil or gas wells—casing recovery	16.90	19.78	17.0
Oil or gas wells—logging	1.02	1.22	19.6
Oil or gas wells—perforating	2.60	3.46	33.1
Oil or gas wells—specialty tool	2.14	2.70	26.2
Oil rig or derrick erecting	9.70	11.46	18.1
Oil well equip. dlrs.—second hand	5.90	7.42	25.8
Oil or gas pipe line construction	7.26	9.61	32.4
Oil or gas pipe line operation	1.33	1.22	*8.3
Oil or gas producing	1.89	1.91	1.1
Oil or gas—still erection or repair	3.31	4.46	34.7
Oil or gas well service by contr.	7.45	9.06	21.6
Oil refining—petroleum	.99	1.01	2.0

* Decrease.

Carriers and assured alike agree that the intent of the Texas compensation law is being mocked by 1) the Holmes decision; and 2) abuses growing out of the lack of authority vested in the Industrial Accident Board.

The Holmes decision, handed down in 1946 by the Texas Supreme Court, is generally held to be a bitter curse upon insurance carriers. It makes it possible, for example, for a highly paid worker to receive as much compensation for a 10 percent leg disability as for the loss of the entire leg.

The Texas Industrial Accident Board, consisting of a lawyer, an employer representative and an employe representative, was set up to administer the Texas Workmen's Compensation Act. But through misuse of the act, the Board has become little more than a stepping stone to the district courts.

The law makes the Accident Board the mediator in claims disputes but provides the right of appeal from its decisions. Moreover, appeals are encouraged by the law, which stipulates that where disputes are tried before the Accident Board, attorneys' fees are to be 15 percent of the first $1000 and 10 percent of all in excess of that amount; but when disputes are appealed to the courts, the attorneys' fees jump to 33 1/3 percent of the award. Thus, if the Accident Board awarded a claimant $5000, the attorney would get 15 percent of the first $1000, or $150, plus 10 percent of the next $4000, or $400, for a total of $550. On appeal to the court, the attorney would receive 33 1/3 percent of the $5000, or $1666.66.

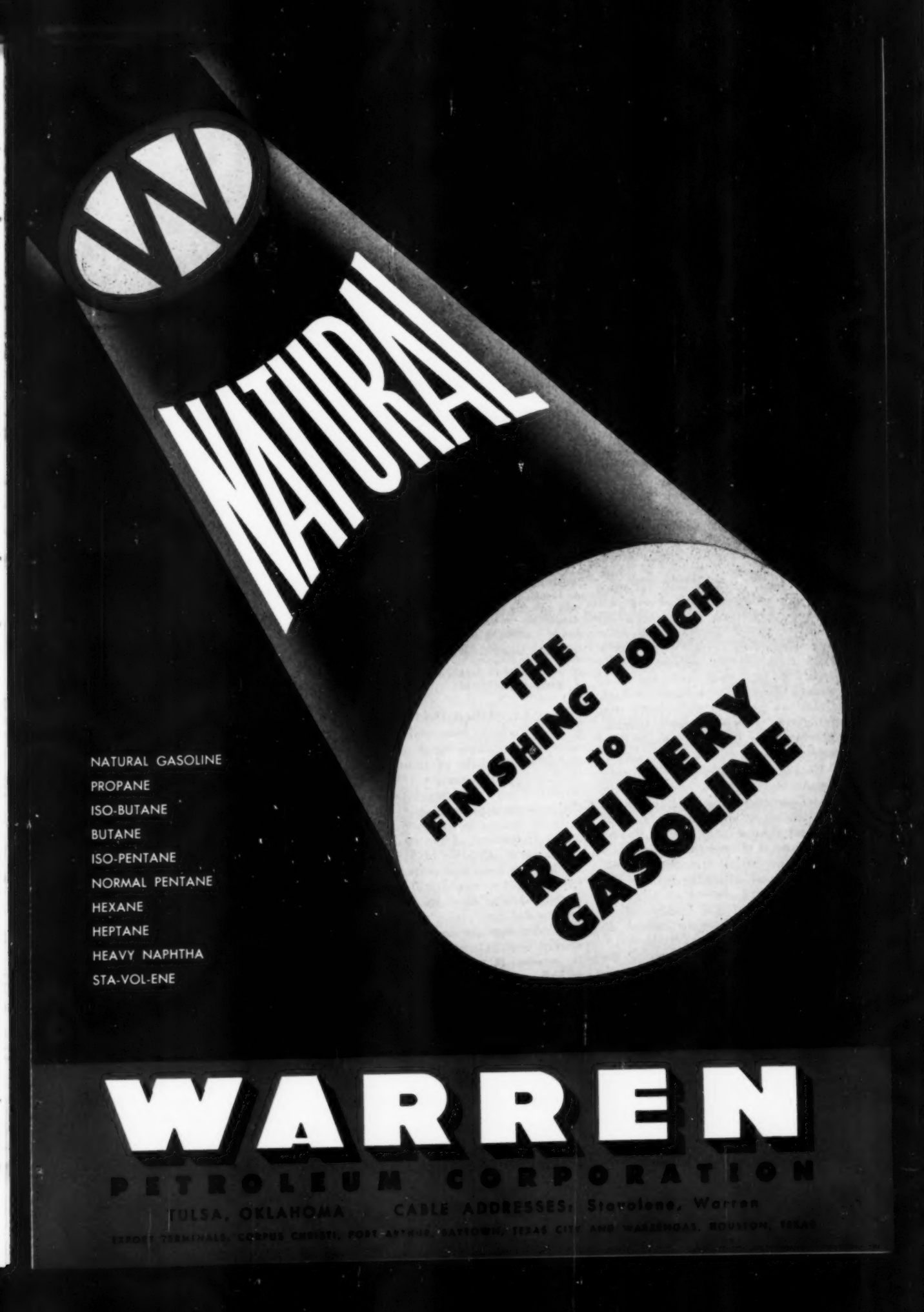
Procedures Elsewhere

(Compensation procedures in some other oil states:

(Oklahoma—Industrial Commission is sole judge of the facts. Appeal can only be made to the State Supreme Court, and then only on points of law. However, attorneys' fees are fixed at 20 percent of the amount awarded, regardless of the amount of work per-

"Industry's Reflections"

This photo of the Indiana Harbor ship canal reflecting lights of Socony-Vacuum Oil Company's plant in East Chicago, took feature classification honors in the Chicago Tribune's annual new photographers' contest. It was made by John Austad. Outstanding news photos taken by Tribune cameramen recently were exhibited, with visitors' votes picking the top three winners.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BUTANE
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formed by the attorney in the case. Hence, there is a mad scramble on the part of workmen's compensation attorneys to obtain representation on these claims.

(New Mexico and Louisiana—Claimant goes directly to the district court.

(Colorado—Claims are settled by the Industrial Commission, which does not encourage attorneys to enter the suits and awards them fees only for the work they actually do. No percentage payment is allowed.)

Actually, a case going to the courts in Texas is not an appeal but a complete new trial in that any opinions expressed by the Accident Board cannot be presented to the jury, which is thereby deprived of the experience and knowledge of the Accident Board.

This situation is aggravated by 1) the average juror's sympathy—and sometimes, it would seem, the judge's also—for the plaintiff's claims as opposed to the rights of the big and impersonal insurance carrier; and 2) the inflationary gap between the $25 maximum weekly benefit allowed under the law and the amount needed nowadays for subsistence. For example, an employe with an average weekly wage of $100 and suffering an injury resulting in 25 percent permanent partial loss of use of a leg would be due 200 weeks' compensation at $15. per week (25 percent x $100. x 60 percent of the average weekly wage allowed under the law). Since $15 is below subsistence level, jurors are prone to make lump sum settlements, frequently the maximum, thereby giving the compensation rates another upward nudge.

Here is an ordinary case illustrating the Accident Board's impotence, the jurors' sympathy for the claimants in the face of strong evidence, and the tendency toward lump sum payments:

A claimant alleged that while climbing a ladder he fell, straddling a rung, and sustained a double hernia. The Accident Board entered an award at the maximum of $25 weekly for an indefinite period not to exceed 26 weeks ($650.) He appealed. In court, the defense produced records of the Industrial Accident Board on two previous claims by the plaintiff, one for a leg injury for which he collected $370, and the other for a back injury on which he collected $3312. Two physicians testified that the plaintiff did not have a hernia. An official of the firm employing the plaintiff at the time of the injury testified that the claimant had come to him saying he would drop the suit if the company would promise him employment.

The jury returned a verdict of total and permanent disability and awarded $10,025.

Oil-Army Training Starts—

D. L. Hines, vice president and Eastern division operating committee vice chairman of Tide Water Associated Oil Company, is shown welcoming 1st Lt. Robert E. Travis and Lt. Col. Joseph A. Thomas (left to right) during the 10-week training program covering oil company operations, held annually through the cooperation of Tide Water Associated Oil Company and the U. S. Army. This training is the concluding phase of the "Petroleum Products Analysis and Control Course," given by the U. S. Army Quartermaster Petroleum School, Caven Pt., Jersey City.

Legislation Drafted

Texas industry's aroused answer to abuses is legislation which would completely overhaul the administration of workmen's compensation. One bill to be introduced at the current session of the legislature provides:

1) A change in attorney's fees to a flat 15 percent of the award, with a maximum limitation of $1500. This would be a considerable reduction in fee levels, but would still allow the attorneys more than the average in other states.

2) An increase in the maximum weekly benefit from $25 to $30 and an increase in the minimum from $9 to $12.

3) Elimination of the method of compensation calculation as set up by the Holmes case.

4) A simpler procedure for taking care of a minor or minor beneficiary to eliminate costly guardianship.

5) A more realistic approach to situations involving pre-existing injuries. An effort would be made to determine how much responsibility the insurance carrier should have for aggravation of an old injury.

6) A provision allowing for self-insurance with adequate safeguards. Self-insurance is now possible only through a separate company.

7) A change in the mediation setup. The Industrial Accident Board would continue with three members but would have final jurisdiction over fact. No appeal would be permitted except on points of law. Traveling commissioners would hear evidence and make determination of claims. Appeal from their decisions would be to the Industrial Accident Board.

Other legislation planned includes verification of the legality of the retrospective rating plan, which though widely used is now the target of at least one suit in Texas. Retrospective rating provides that between designated minimum and maximum limitations, the actual losses of the individual assured shall govern the premium for the risk. It is superimposed on the regular rating procedure and adjusts the standard premium to the actual risk conditions.

There will also be legislation to set up an Assigned Risk Pool or Plan under which risks otherwise unacceptable would be distributed among the insurance carriers.

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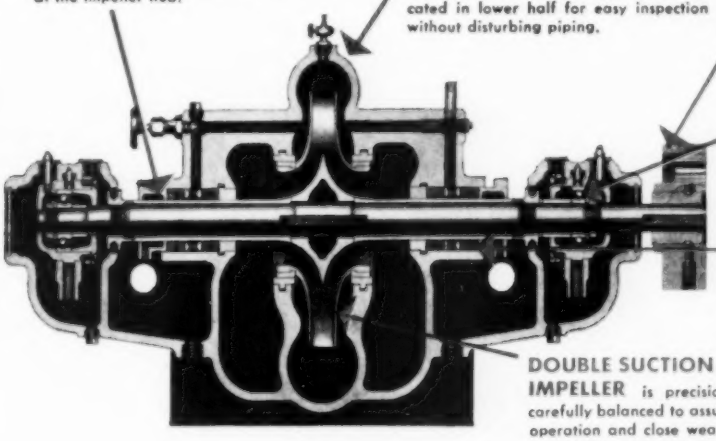

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Gulf Research Adds Number 25—

Gulf Research & Development Company is not a collector of valuable writings but it does have three stories worth $1 million. The three stories along with a basement make up the company's new chemistry laboratory, recently completed at Harmarville, Pa.

The new structure represents a substantial addition to Gulf's research facilities and becomes the thirty-fifth building devoted exclusively to petroleum research at the Harmarville center. So arranged as to allow easy conversion of any office into a laboratory by a short extension of service lines, the new lab has 31,600 feet of gross floor space.

[Who's Building]

Refining Capacity Goes Up as Canadian Expansion Continues

To Canada's rapidly growing refining facilities, Riverlake Oil Ltd., will soon add a 4000-barrel-a-day refinery at Fort William, Ontario. The new plant will cost around $1 million.

Among further boosts to the country's capacity are two projects in the two Prairie Provinces.

Consumers' Co-operative Refineries, Ltd., has a $5.5 million modernization and expansion program outlined for its Regina, Saskatchewan, refinery, with construction due to begin early this year. Wainwright Refineries, Ltd., is already working on an expansion project to step up its Wainwright, Alberta, refinery capacity from 300 to over 600 barrels a day.

Since 1947 Canada's refinery capacity has increased from approximately 263,000 barrels of crude oil per day to a present level of 454,700 barrels. This is an increase of about 73 percent. Current construction will boost this figure by another 15 percent within the next year to year and a half.

Esso Standard Now Completing $25 Million Antwerp Refinery

The 25,000-barrel-a-day refinery of Esso Standard Refinery S. A., now under construction at Antwerp, is expected to go into operation in April. The Belgium refinery will cost about $25 million.

Standard Oil Company (New Jersey), of which the operating company is a subsidiary, subscribed almost the entire capital of about $6 million for the Belgium-incorporated company and made major loans for the project. In addition, the Belgium government made available the equivalent of about $18 million through the National Company for Industrial Credit.

$75 Million Shell Plant Hangs On State Land Law Amendment

Shell Oil Company plans to build a $75 million refinery in the Puget Sound area provided the Washington State alien land law is amended to permit the company to own land in the State.

The law now prohibits land ownership by aliens. The proposed amendment was to be introduced in the state legislature, which convened in Olympia, Wash., last month, by state representative Newman H. Clark of Seattle.

Ford Elvidge, Seattle attorney for Shell, said a clarification of the law is necessary to justify the proposed investment. Shell is a Delaware corporation, but is controlled indirectly by Batavian Petroleum Company, a Dutch corporation. Details of the proposed refinery have not been announced.

Imperial Oil Readying Units In $15 Million Modernization

The first unit of a $15 million expansion and modernization program has gone into operation at the Sarnia, Ontario, refinery of Imperial Oil Limited. Oil has already been run through a new atmospheric and vacuum distillation unit preparatory to start of operations.

A fluid catalytic cracking unit and a light ends recovery unit are due to be cut in on the production stream sometime this month.

When all the new units are in operation, the throughput capacity of the Sarnia refinery will be increased from 55,000 barrels a day to 71,000 barrels a day.

Western States Ups Capacity

New facilities now under construction at Western States Refining Company's North Salt Lake City refinery will boost the refinery's capacity from 2000 to 3000 barrels a day.

DPA Approves $8.5 Million For Shell Tax Amortization

Shell Oil Company's grant for $8.5 million for refining facilities at Houston leads oil projects approved by Defense Production Administration for rapid tax amortization from the middle of January to the middle of February. Shell received a write-off of 65 percent on $5.7 million and 45 percent on $2.8 million.

Other companies granted DPA approval, with location, type of facility, amount certified and tax write-off rate, were:

Standard Oil Company (Indiana)—Wood River, Ill., refining expansion, $4.3 million, 65 percent; $3.4 million, 45 percent.

Cal-Tex Refining Company—Colorado City, Texas, petroleum refining, $903,525, 65 percent; $30,000, 50 percent.

Phillips Petroleum Company—Upton County, Texas, petroleum refining, $4.8 million, 65 percent.

Phillips Petroleum Company—Dumas, Texas, gasoline refining, $223,000, 65 percent.

Anaconda Copper Mining Company—Anaconda, Mont., sulfuric acid, $1.4 million, 70 percent.

Warren Petroleum Corporation—Panther Creek, Okla., propane, butane, natural gasoline, $481,500, 65 percent; $128,000, 40 percent.

Expansion And Modernization Set For Shallow Water Refinery

Plans for an extensive expansion and modernization at its Shallow Water, Kan., refinery have been announced by Shallow Water Refining Company. The project involves construction of a new 3000-barrel-a-day catalytic cracking unit and auxiliary facilities, plus enlargement of an existing catalytic polymerization plant.

Shallow Water's refinery now has a capacity of 4000 barrels a day of crude oil, 1300 barrels a day of thermal cracking.

IROM Ups Refinery Capacity With Thermal Reforming Unit

Industria Raffinazione Olii Minerali (IROM), which was established in 1947 by Anglo-Iranian Oil Company, Ltd., and Azienda Generale Italiana Petroli, has placed on stream a new thermal reforming unit which will process about 7000 barrels of naphtha daily.

The new unit, a part of the IROM-operated Porto Marghera refinery at Venice, Italy, will boost the plant's capacity to about 280,000 tons annually of gasoline.

Portland Gasoline's Plant Becomes Part of Kerr-McGee

Kerr-McGee Oil Industries has purchased the Portland Gasoline Company's natural gasoline plant six miles west of Pampa, Texas, for what has been termed "in excess of a million dollars." The plant has a capacity of 33 Mmcf of gas daily, converting vapor into liquid fuel.

Blending Plant Expanded in Deep Rock Modernization Move

Deep Rock Oil Corporation's multi-million dollar modernization program planned for its lubricating oil manufacturing facilities has moved into its first

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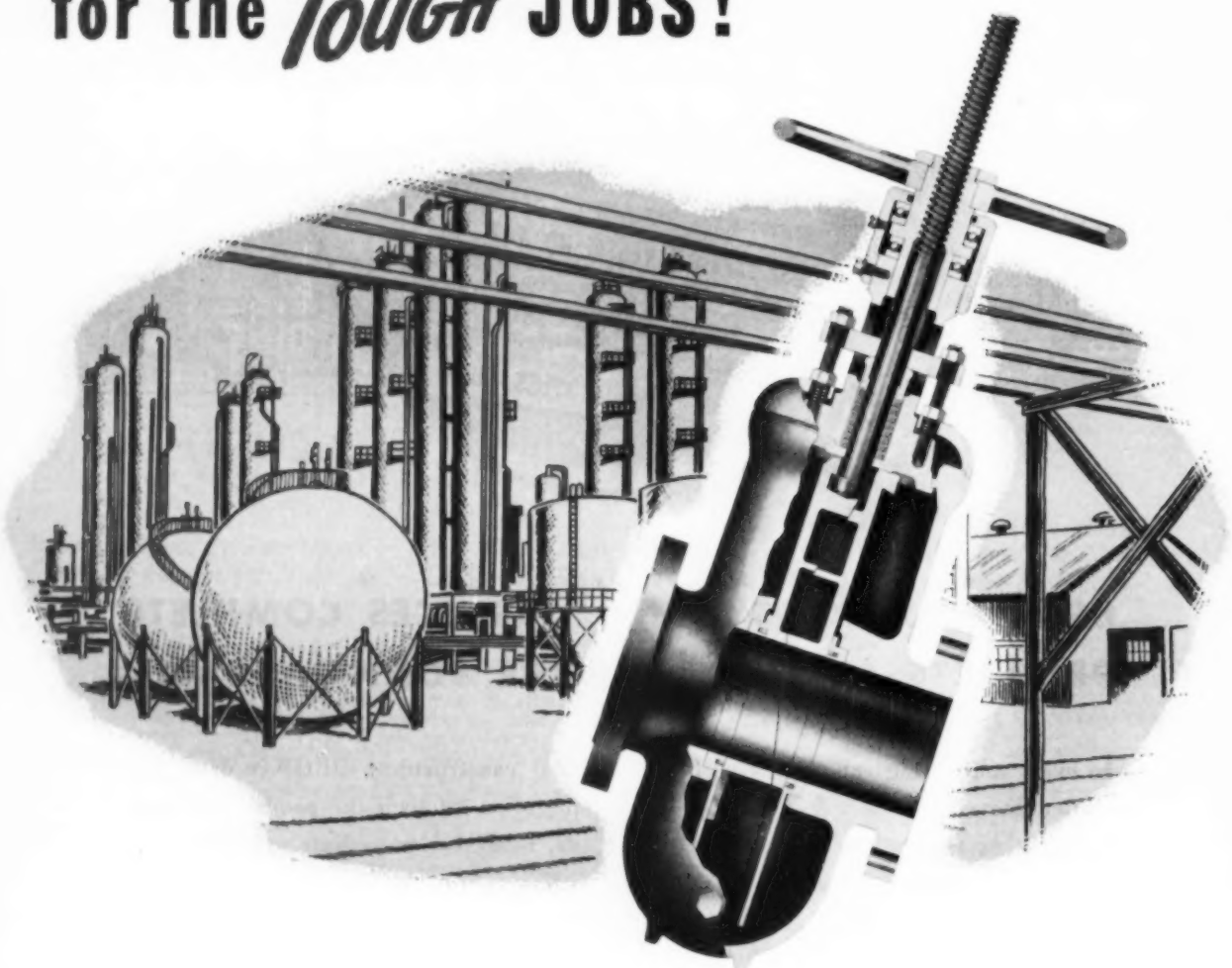

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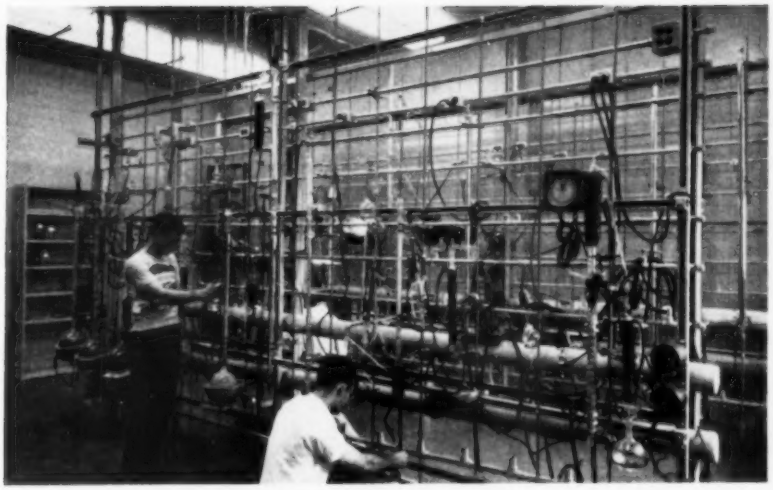

Celanese Opens Petrochemical Research Lab—

Setting up and checking distillation columns in the distillation room is preliminary to the scientific investigations in the field of petrochemistry now being carried on in the new research laboratory which Celanese Corporation of America recently opened at Clarkwood, Texas.

The new office and laboratory building, operated by the research and development department of the company's chemical division, contains 21,000 square feet of floor space. It houses 11 separate laboratories; 27 offices; a library; conference room; drafting room; duplicating room and lobby.

phase with the expansion of the company's blending and packaging plant at Cushing, Okla.

Newest installations provide for improved packaging and materials handling facilities, a complete drum reconditioning line, greater warehouse and outloading capacity and increased blending capacity.

Chemical Plants division, Blaw-Knox Construction Company, designed and constructed the new facilities, utilizing previously existing structures at the Deep Rock plant.

Lummus Is Prime Contractor For Indiana Standard Refinery

Standard Oil Company (Indiana) has selected Lummus Company as the prime contractor for construction of its new Williston Basin refinery at Mandan, N. D.

Final design of the 30,000-barrel-a-day refinery is now being completed. Construction is expected to start in the late spring of this year. Completion and initial operation of this first Williston basin refinery is scheduled for October, 1954.

In addition to the refining unit, tanks will be erected for storage of both crude oil and products. Treating and blending facilities will also be provided.

Phillips Projects Doubling of Woods Cross Refinery Capacity

Plans for a 50 percent expansion of its Woods Cross, Utah, refinery have been announced by Phillips Petroleum Company.

A $10 million catalytic cracker recently dedicated at the refinery has increased the plant's crude oil capacity from 5000 to 12,000 barrels a day. This cracker can be expanded to a capacity of 18,000 barrels a day. This expansion will likely take place in 1954.

Repair of Explosion Damage Begins at Shell Texas Plant

Four men were killed and an estimated $350,000 in damage done by a blast which ripped through the $10 million Shell Oil Company recycling plant at Sheridan, Texas, last month.

It has been speculated that the explosion was caused by oil from a leaking valve that somehow became ignited by a spark.

Shell Oil Company has since announced that work will begin immediately to repair the damage. Company officials said that Fluor Corporation has been awarded the reconstruction contract.

The damage was confined to the plant's fractionation and distillation area. Construction work will take an estimated four months.

Pan-Am Southern Operating Louisiana Hydroforming Unit

What is termed the world's first fluid hydroforming unit, designed to upgrade heavy naphtha, has gone into operation at the Destrehan, La., refinery of Pan-Am Southern Corporation.

Pan-Am worked with Standard Oil Company (Indiana), its parent, and The M. W. Kellogg Company to perfect the new process. The new unit has a charge capacity of 2500 barrels a day and yields high-octane "hydroformate" for blending to manufacture motor fuels or aviation gasoline.

Champlin Refining Considers Cat Reformer at Enid Refinery

Installation of catalytic reforming facilities at Champlin Refining Company's Enid, Okla., refinery is now under consideration by engineers.

Champlin's 20,000-barrel-a-day refinery is now operating with thermal reforming and cracking.

Three Ask Permission to Build Absorption Plant in Alberta

Texaco Exploration Company has applied to the Alberta petroleum and natural gas conservation board for a permit to build a $2 million gas absorption plant east of Edmonton, Alberta.

Two other firms have also applied to the board for permits to build plants in the Edmonton area.

Barcam, Ltd., proposes to construct a $10 million absorption plant near the city. It would use "flare" gas piped from 11 oil fields in the district and would process 35 Mmcf of gas daily into 45 million gallons of propane and butane, beside 15 million gallons of natural gasoline and other liquid products a year.

Leduc Southern Absorption, Ltd., wants to erect a $2 million plant near Ireton to process gas from the Leduc-Woodbend sector of the Edmonton oil field.

$13 Million Ammonia Plant Is Projected by Brea Chemicals

Brea Chemicals, Inc., subsidiary of Union Oil Company of California, has announced it will lease and operate an especially designed $13 million plant to be built at Brea, Calif., for the manufacture of ammonia for western agriculture and industry. The ammonia will be made from natural gas taken from wells near Brea.

Amoniaco Corporation will build the chemical plant and finance its construction. C. F. Braun & Company has been selected by Amoniaco to construct the plant which is scheduled for completion in the summer of 1954.

Shell $8.5 Million Extension Is Planned but Not Scheduled

Plans to build an $8.5 million extension to its Deer Park, Texas, refinery lubricating oil plant have been drawn up by Shell Oil Company, but construction is not scheduled to begin in the near future.

A shortage of lubricating oil and processing units which existed when the extension was planned has been overcome, F. S. Clulow, Shell Oil's vice president in charge of manufacturing, said. The lubricating plant extension is not now considered an emergency, he added.

The Shell executive indicated there is a possibility that the plant will never be built. The present plant has a capacity of 3800 barrels a day.

Rapid tax write-offs were granted Shell in the form of two certificates: $5.6 million, 65 percent write-off; and $2.8 million, 45 percent write-off.

Celanese Producing Acetic By New Process at Texas Plant

Acetic acid and acetic anhydride are being produced by an entirely new process in the new $17 million petrochemical plant of Celanese Corporation of America at Pampa, Texas.

While acetic acid and acetic anhydride are the principal chemicals being made during the initial phase of operations, derivatives of these chemicals will eventually be produced. Units to produce the derivatives will be built as soon as

# of PROGRESS—

Juggling the world's smallest components—atoms and elements—demands the services of some of the world's largest, strongest and most complicated equipment. The petroleum, petrochemical, chemical and atomic energy industries have marched forward in seven-league boots because gigantic plants like Sun Ship have been able to make the "boots." . . . They have kept pace with the engineering needs of the industries . . . have been able to place in the scientist's hands the "tools" which enable him to mold elements as old as the world into products as new as today.

There has been what might be called a chemistry of progress at work in Sun Ship's mighty plant to match the progress of chemistry. The services of its great shops, the skills of its thousands of workers, have been adapted like atoms into new patterns which enable the great plant to make and fabricate the array of equipment . . . the engines and machinery . . . pressure vessels . . . fractionating towers . . . stills . . . tanks . . . catalytic cracking cases and other equipment which serve modern chemistry in building a greater America.

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work on the present facilities is completed.

The new plant likewise increases Celanese production capacity for methanol and acetone.

Dow Begins Construction of Styron Manufacturing Plant

Construction has begun on The Dow Chemical Company's new 72,000-square foot plant at Torrance, Calif., which will manufacture styron, a polystyrene plastic material used for conversion into plastic products.

Facilitis for the plant will include equipment for making plastic granules in a variety of colors in addition to making uncolored granules. Scheduled for completion in the fall of this year, the new plant will be a part of Dow's three phase program for increasing styron production facilities. Dow recently added to its plastics building in Midland, Mich., and put a newly completed plant at Allyn's Point, Conn., into full production last October.

Sunset Oil Moving Along in Torrance Refinery Expansion

The $1 million expansion program at Sunset Oil Company's Torrance, Calif., is well advanced, Morton Sterling, vice president, has said. A 2800-barrel-a-day thermal cracker and a 100-barrel-a-day polymerization and hydrogen sulfide removal unit are being installed as part of the project.

Crude throughput of the plant will not be affected by the program. Clark and Gosselin, Long Beach, Calif., refinery consultants, handled engineering on the project.

As part of the program, the former Eagle Oil and Refining Company at Santa Fe Springs, Calif., has been disassembled, re-engineered and expanded, and now is being installed at Torrance.

United Refining Gets License For New Catformer at Warren

The Atlantic Refining Company has announced the addition of The United Refining Company to its list of Catformer licensees. Warren is building a 2500-barrel-a-day Catformer at its Warren, Pa., refinery with Blaw-Knox Construction Company of Tulsa acting as designer and contractor. Completion of the plant is scheduled for August, 1953.

Indiana Standard to Construct 30,000-Barrel Dakota Refinery

Standard Oil Company (Indiana) will soon begin construction of a 30,000-barrel-a-day refinery at Mandan, N. D. The site has been under option since June, 1952. Plans call for completion of the plant by November, 1954.

When completed, the Mandan refinery will include modern equipment for crude oil distillation, catalytic cracking, polymerization, vapor recovery, finishing and shipping.

Dow Puts New Plant On Stream

The Dow Chemical Company has begun operating a new perchloroethylene plant at its Plant B at Freeport, Texas. The new unit provides new production capacity for three principal products: perchloroethylene, carbon tetrachloride and hydrochloric acid.

Davison to Use New Process in Sodium Silicate Production

Facilities to manufacture petroleum cracking catalysts and other chemicals are being built by The Davison Chemical Corporation at Lake Charles, La. A plant for the production of sodium silicate in both solid and solution form, by a new process, is included in the new units.

This will mark Davison's entry into production of sodium silicate—often referred to as "water glass" in its solution form—a chemical used extensively by the company in the production of petroleum cracking catalyst, other catalysts and silica gels.

The Lake Charles facilities will have a capacity of about 300 tons per day of sodium silicate. The process to be used was developed by Cowles Chemical Company. Davison is the first and only licensee to date.

New LP-Gas Storage Terminal Established by Cities Service

Cities Service Oil Company has established an LP-Gas storage terminal one mile west of Hutchinson, Kan. This terminal will include underground storage capacity of approximately 4 million gallons, some above-ground storage, and rail and truck loading and unloading facilities.

The underground storage will be washed out of the salt formation underlying the acreage just leased by Cities Service. Fresh water will be circulated to dissolve and remove salt from four caverns, each of which will have storage capacity of 1 million gallons of propane.

Aurora Gasoline Schedules UOP Platforming Unit at Elsie

A UOP Platforming unit will be installed at Aurora Gasoline Company's Elsie, Mich., to produce high-octane motor fuel. Aurora has been operating another Platformer at its Detroit refinery since 1951. Universal Oil Products is licensing the Platforming process to the company.

The Elsie Platformer will have a design capacity of 1500 barrels a day compared with 4500 at Detroit. Procon has been awarded the construction contract for the unit.

Natural Gas Refinery Planned For New Mexico by Atlantic

Plans for construction of a natural gas refinery with a capacity of 25 Mmcf. of gas daily have been announced by The Atlantic Refining Company. To be built near Lovington, N. M., the plant will be a joint project of 26 companies and individuals operating in the Denton field in New Mexico.

Contracts have not been let and the company has declined to make a cost estimate. However, construction is expected to start "right away."

Pacific Plans New Refinery

Erection of a 10,000 barrel a day oil refinery on Puget Sound, near Seattle, Wash., is being planned by Pacific Oil and Refining Company. The new construction will operate on Canadian crude delivered from the Trans Mountain Pipe line now under construction from oil fields in Alberta.

[Who's Building]

Mid-Continent Expanding at West Tulsa Refinery Under DPA

Defense Production Administration has granted a certificate to Mid-Continent Petroleum Corporation approving accelerated amortization of 65 percent of $536,015 for new and expanded facilities at the company's West Tulsa, Okla., refinery. The company has already begun construction on a new 10,000-barrel-a-day cracked-gasoline debutanizer under the certificate.

Additions to the plant's catalytic cracker will raise its capacity to about 21,000 barrels a day from 16,000 barrels a day. Completion of the construction is scheduled for next Spring.

Esso Standard Modernizing 135,000-Barrel Bayway Plant

Modernization is underway at Esso Standard Oil Company's 135,000-barrel-a-day Bayway, N. J., refinery. Included in the new installations are a 60,000-barrel-a-day two-stage pipe still, a 20,000-barrel-a-day Hydrofiner and a high viscosity fuel burning system.

Hydrofiner, with separate reactor sections for naphtha and heating oil, embodies a process being pioneered by Standard Oil Development Company. Esso's project will be the first unit of its kind to be built.

The new units are expected to be completed by the middle of 1954.

AIOC and Shell to Combine on British Refinery at Mombasa

Anglo-Iranian Oil Company and Shell Oil Company will collaborate on the construction of a large refinery at Mombasa, the main port of Kenya and of all East Africa, according to official British sources. The project results from the loss of the huge petroleum installations at Abadan to the nationalist tide and will cost an estimated $196 million.

About $6.5 Million Estimated For New Ashland Facilities

Ashland Oil & Refining Company has estimated that it will spend another $5 million for completion of new facilities at its Frontier refinery at Buffalo, N. Y., and about $1.5 million for presently contemplated improvements at the Catlettsburg, Ky., and Findlay, Ohio, refineries.

Cities Service Increasing Indiana Refinery Capacity

A three-year, $12 million project at the East Chicago, Ind., refinery of Cities Service Oil Company (Del.) will increase the plant's capacity from the present 40,000 barrels a day to 15,000 to 20,000 barrels a day.

This construction is now underway and is a part of Cities Service's $57 million program for 1953.

Wesco to Add Cracking Plant

Wesco Refining Company will add a 1250-barrel-a-day cracking plant to its skimming plant at Rangely, Colo., this year. Present plans call for the new plant to be on stream by November 1, 1953.

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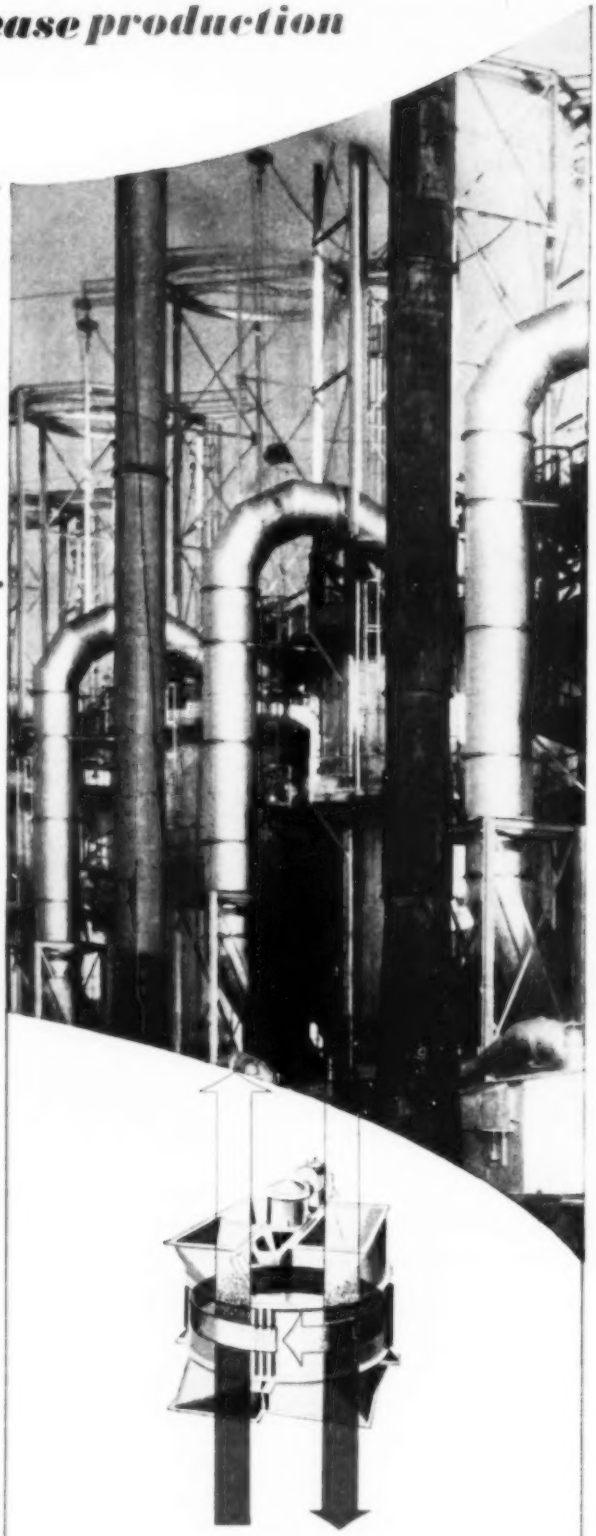

Slag – primary cause of reduced capacity – can be practically eliminated by the use of a Ljungstrom Air Preheater.

That's because preheated air mixes more thoroughly with the fuel. Therefore, less excess air is required for complete combustion – and less combustible material is lost in the flue gases.

Thus, with a Ljungstrom Air Preheater, there is less material present in the furnace for slag production. Oil tubes stay cleaner . . . longer. Stills stay on stream *at top production* for months longer.

For example, a pipe still in an eastern refinery dropped from 16,000 barrels a day to 12,000 because of slag. Now, with a Ljungstrom Air Preheater and modern high-temperature burners, the still operates *continuously at 18,000/20,000 barrels.*

This saving alone can pay for a Ljungstrom installation in less than a year. Add it to more economical furnace design possible . . . up to 20% fuel savings . . . greater heat recovery even from low grade fuels . . . higher through-put – and you can see why the Ljungstrom Air Preheater is perhaps *the most significant guidepost to economy available today to refiners.*

For more complete details on what the Ljungstrom Air Preheater can do for you . . . for an analysis of the heat recovery benefits attainable in your fuel burning equipment – call or write The Air Preheater Corporation today.

The Ljungstrom operates on the continuous regenerative counter-flow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

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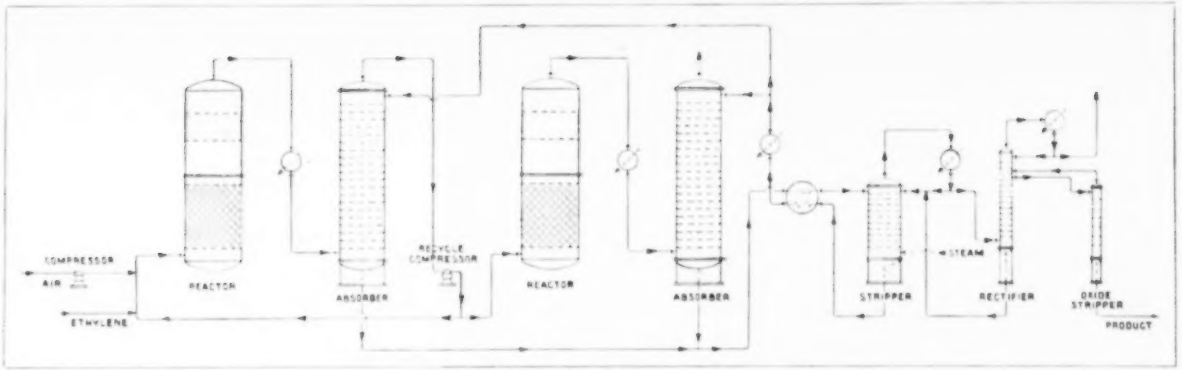


Flow diagram for ethylene oxide process.

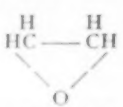
New Process for Ethylene Oxide By Direct Oxidation

Atlantic-Vulcan development makes possible yields of 55 to 65 percent based on ethylene

Thomas E. Corrigan
The Vulcan Copper & Supply Company,
Cincinnati

A NEW process for the manufacture of ethylene oxide by direct oxidation of ethylene has been developed by The Vulcan Engineering Division and The Atlantic Refining Company. The process makes use of a fluidized catalyst bed.

Ethylene oxide is a highly reactive organic compound containing two carbon atoms and oxygen in a ring structure. The structural formula is:



In addition to its being highly reactive, it is flammable, and toxic. It is a water white liquid (boiling at 51 F.) which will blister the skin on contact. Its volatility and flammability make storage and handling a problem. The highly reactive properties make it a valuable intermediate in the organic chemical industry. The principal use of ethylene oxide today is in the manufacture of ethylene glycol (permanent anti-freeze). Roughly, about 80 percent of the ethylene oxide produced finds its way into the automobile radiator. Other uses are in the production of non-ionic detergents, ethanolamines and acrylonitrile (raw material for some of the new synthetic fabrics).

Ethylene oxide has reached the status of a "heavy" chemical, 81,207,000 pounds having been sold in 1951, besides additional amounts used under "captive" conditions.

There are two methods of manufacturing ethylene oxide. The old established method (the chlorhydrin process) gives a higher yield of product based upon ethylene consumption but requires chlorine and lime as additional raw materials.

The chlorine requirement is the "hooker" in this process. Chlorine is costly and scarce. New ethylene oxide facilities by the chlorhydrin process must therefore include the additional capital for the required chlorine facilities.

Since the present trend of chlorine prices is up and ethylene prices down, the process economics tend to favor the other process, direct oxidation.

In the direct oxidation process, air and ethylene are passed over a catalyst at a temperature between 400 and 600 F. and at atmospheric or moderate pressures. The process may be carried out in either a fixed or fluidized bed.

The basic reactions involved are:

$$C_2H_4 + 1/2O_2 \rightleftharpoons C_2H_4O \quad (1)$$

$$C_2H_4 + 3O_2 \rightleftharpoons 2CO_2 + 2H_2O \quad (2)$$

The whole trick of any direct oxidation process is to obtain as much of Reaction (1) and as little of Reaction (2) as possible. Reaction (2) is highly exothermic—and is promoted by high temperatures. If it gets too good a start, local hot spots will develop—and yields decrease. For this reason good temperature control in the catalyst bed is essential.

This process overcomes the problem of local overheating in the catalyst by employing a fluidized bed. With the catalyst in the form of fine particles in constant agitation, excellent heat transfer is provided and a very nearly "isothermal" catalyst bed is maintained. A unique feature of the process is the development of a fluid bed reactor which minimizes backmixing and thereby has less secondary reaction or product decomposition than would be present in the conventional fluid bed reactor. The reactor consists of a series of parallel tubes, each containing fluidized catalyst. Especially designed orifices maintain a uniform pressure drop over the reactor tubes. This maintains uniform gas flow. The use of a layer of catalyst above the reactor tubes maintains uniform catalyst distribution and provides stable operation.

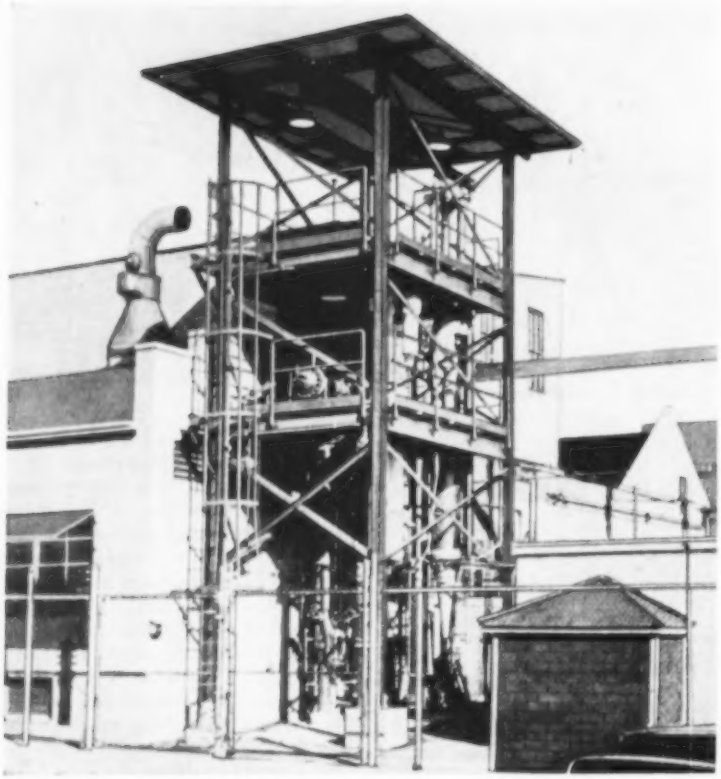
In the design of any one plant, the process variables can be adjusted so as to give the most economical combination of capital cost and yield which fit the specific conditions of raw material, utilities and labor costs.

Description of Process

In principle, the process is simple. Ethylene is oxidized by air over the silver catalyst. The product is recovered from the gas stream by absorption, the absorbate is stripped with steam, and the product is recovered by distillation. In detail, it is more complicated.

Reactor Section

A mixture of air, ethylene, and recycle gas under pressure are passed through fluid bed multitube reactors operating in parallel. Each reactor contains a number of tubes, each of



In this pilot plant, the principle of the multiple fluidized reactor was verified and the effects of process variables were determined.

which is filled with a fluidized silver catalyst. The amount of catalyst used is sufficient to provide a layer above the tube sheet during operation. This assures equal distribution of catalyst in the tubes. The distribution of gas is controlled by means of restrictive orifices at the inlet to each tube.

A dowtherm system is used to remove the heat of reaction and control the temperature in each reactor. Since the tube area is more than that required for heat transfer alone, and since the catalyst is in constant agitation, heat removal and temperature control are not a problem.

The dowtherm vapors produced in the reactors are condensed in a waste heat reboiler which generates steam for use in the process. A standard gas-fired dowtherm heater is provided for startup.

The reaction is quenched immediately after leaving the catalyst bed by passing the reacted gases over cooling tubes. These tubes are inside the reactor, just above the reaction tubes. Filters in the top part of the reactor remove any catalyst which might remain in the gas stream. In pilot plant operation there has never been any appreciable catalyst buildup on the filters.

After leaving the reactors, the gases are further cooled in a finned tube gas cooler. The ethylene oxide is removed from the gas stream in the primary absorber using water as the absorbent.

The oxide-free gas is then recompressed, and part of the stream is reintroduced, along with fresh ethylene and air, into the primary reactors. The remaining part of the recycle stream is reenforced with a small amount of additional air and fed into a second-stage reactor similar to, but smaller than, the primary reactors. The second stage reactor is operated on a once-through basis, that is, no recycle is used in the secondary system. The gas from the second stage reactor is cooled and passed through the second stage absorber. The oxide-free gas from the second stage absorber may be either vented at this point or passed through a third stage system for further product recovery.

Recovery Section

The absorbate from both absorbers is combined into one stream and treated in a single recovery system. A shell and tube heat exchanger is used to preheat the absorbate before it is fed to the stripper. The heating medium is the stripped absorbent. The preheated absorbate is fed to the stripping column (a bubble cap tower especially designed for high liquid flows). The stripped absorbent is cooled by the incoming absorbate and returned to the absorbers. A surge tank and an additional shell and tube heat exchanger are in the stripped absorbent stream to assure steady flow and temperature control of the feed to the absorbers.

A mixture of ethylene oxide, water vapor and carbon dioxide from the stripper pass into a partial condenser which knocks down a large portion of the water which is returned to the stripper. The uncondensed vapors enter the base of the rectifying column. Bottoms from the rectifying column are returned to the stripping column.

A side stream from the rectifying column containing the ethylene oxide product draw-off and some dissolved carbon dioxide is sent to a stripping column for removal of the last traces of carbon dioxide.

The bottoms from the oxide stripper are cooled and pumped to storage. The product is stored in pressurized spheres under an inert gas blanket.

The vent gas from the rectifying column condenser consists mainly of carbon dioxide with small amounts of nitrogen, ethylene and oxygen which were dissolved in the absorber plus a sizable percentage of ethylene oxide vapor. This stream is passed into a vent gas scrubber for the recovery of the ethylene oxide. The bottoms from this column are returned to the main stripping column for recovery of the ethylene oxide.

Dowtherm System

The oxidation of ethylene produces heat which must be removed continuously to maintain the proper temperature in the reactor. The heat produced is removed by vaporizing dowtherm on the shell side of the reactor tubes. The temperature of the system is regulated by controlling the pressure at which the dowtherm is vaporized. The vapors are then condensed in a steam generator to produce moderate pressure steam for use elsewhere in the process.

A gas-fired liquid heater is provided for startup to heat the dowtherm which is circulated through the reactor shell until the catalyst is brought up to reaction temperature. In this manner, it is possible to have liquid in the reactor when the reaction begins, thus providing immediate control of the reaction temperature.

Under normal operation, the dowtherm vapors produced in the reactors pass through a level drum to the steam generator where the vapors are condensed on the shell side of a multishell vertical heat exchanger. The liquid return dowtherm is introduced into

the level drums where it contacts the rising vapors. This enables a more even temperature to be maintained in the reactors. Control valves are provided for each reactor to control the pressure on the dowtherm in the reactors.

Each reactor is provided with a large drain to a storage tank for removing the dowtherm rapidly in case of emergency, and provisions for cooling the hot dowtherm are provided. A by-pass is also provided so that cold dowtherm from storage may be pumped through the reactor for rapid cooling for shutdown purposes.

A treated water system is provided in order that hot water may be used as a cooling medium in the reactor quench coils and also to provide heat to the oxide stripper reboiler. This system makes use of condensate from steam turbines and also provides preheated boiler water to the steam generator.

Catalyst Handling

The plant is designed so as to include facilities for the preparation of the catalyst. The raw materials are measured and prepared in equipment especially designed for that purpose. The catalyst is activated and then conveyed by air and screw conveyor to storage. It may be charged to the reactors by means of a portable screw conveyor, or by pneumatic transmission.

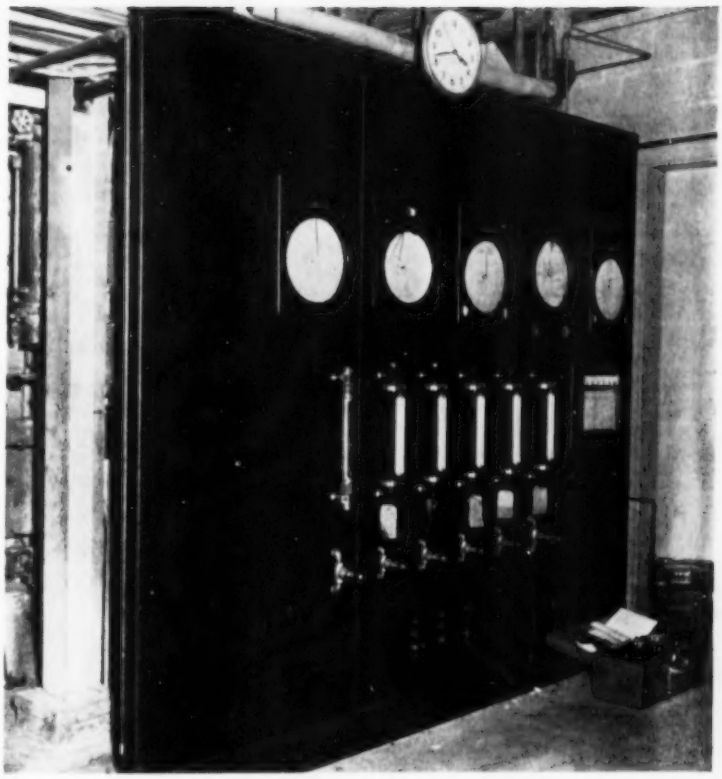
Instrumentation

The instrumentation of this process is quite straightforward and simple. There are no particularly difficult control problems involved. Complete automatic instrumentation is used to maintain steady flow conditions in all parts of the system and to insure a low operating labor requirement.

In general, the instruments specified for the control and indication of process variables are the transmitting type of primary elements. Most of the receivers are of the small type amenable to use with a graphic panel.

In the control of the reactor section, flow and flow ratio controls are used to maintain the correct composition and flow of each stream. A standard temperature multipoint recorder is used to check temperatures at various points within the system.

The recovery system does not represent any special control problems either. The stripper is kept in control by flow and pressure controllers. The interaction of the stripping column, partial condenser and rectifying column is maintained by the use of flow ratio controllers. Pressure and liquid level controllers are used on the columns.



View of control panel in ethylene oxide pilot plant.

The major pieces of process equipment are the reactors and absorbers in the reactor section; and the water stripper, rectifying column, oxide stripper, and vent scrubber in the recovery section. Of these, only the reactors are novel pieces of equipment. The columns are of the standard type used throughout the chemical and petrochemical industry.

The reactors are tall, cylindrical vessels, each divided into three parts. The lower section contains the catalyst bed and consists of a series of parallel tubes. The mid-section, containing cooling coils, is used to quench the reaction mass; and the upper section contains filters to remove catalyst from the gas stream.

The major mechanical accessories are the air compressor, recycle compressor, and a refrigeration system for the ethylene oxide condenser. If the plant has refrigerated brine services, the latter is not required.

Whether the compressors be reciprocating or centrifugal, depends upon an economic balance between capital cost, maintenance, steam costs, and fuel gas costs. Steam turbine driven centrifugal compressors are preferred but, in cases where an extremely low price natural gas is available and steam costs are high, reciprocating compressors with gas engine drives may be used. In the latter case, piston lubrication becomes a problem. The extra maintenance cost of non-lubricated compressors is a factor which also enters into the economic balance.

The major utility consumption is steam if centrifugal compressors are used, or fuel gas if gas engine drive reciprocating compressors are used.

Cooling water and electricity requirements are moderate. The cooling water requirement is dependent upon local conditions. The electricity requirements are for plant lighting and drives for miscellaneous small pumps. The one major pump in the process (the recirculating water pump) has a steam turbine drive.

Economics of the Process

The economics of the direct oxidation are such that the process is a natural for future ethylene oxide expansion. An individual plant can be designed with an over-all yield anywhere between 55 and 65 percent based on ethylene. The greater the yield, the greater is the capital cost. Present ethylene and utility costs seem to indicate that a plant having an over-all yield of 55 to 60 percent can be expected to result in an optimum manufacturing cost.

TABLE 1

Inspection of Aromatic Products From Udex Unit

	BENZENE		TOLUENE		XYLENE	
	ASTM Nitration Grade Specs.	Udex Product	ASTM Nitration Grade Specs.	Udex Product	ASTM Nitration Grade Specs.	Udex Product
Specific Gravity	0.8820-0.8860	0.8849	0.8690-0.8730	0.8724	0.8650-0.8700	0.8724
Color	x	Passes	x	Passes	x	Passes
Solidifying point, °C.	> 4.85	5.49	.....	.....	.....	.....
Acid wash color:						
Acid phase	<2	0	<2	0+	<6	0+
Hydrocarbon phase	No change	Passes	No change	Passes	No change	Passes
Acidity	No free acid	Passes	No free acid	Passes	No free acid	Passes
Sulfur compounds	Free of H_2S and SO_2	Passes	Free of H_2S and SO_2	Passes	Free of H_2S and SO_2	Passes
Sulfur, weight percent	.....	.....	.....	.....	.....	0.0008
Copper corrosion	xx	Passes	xx	Passes	xx	Passes
100 Ml. Distillation:						
Range, °C.	<1	0.6	<1	1.0	<3	2.6
Included temperature, °C.	80.1	Passes	110.6 ± 0.1	Passes	139.3	Passes
Initial boiling point		79.8		110.2		139.0
10 percent		80.0		110.4		139.2
50 percent		80.1		110.8		139.8
90 percent		80.2		111.0		140.4
End point		80.4		111.2		141.6

x Not darker than solution 0.0030 g. $K_2Cr_2O_7$ in one liter of water.
xx No iridescence or discoloration.

Cosden Produces Nitration-Grade Aromatics

THE WORLD'S first Platformer-Udex combination designed for the production of nitration grade benzene, toluene and xylene went into operation at the Big Spring, Texas, refinery of Cosden Petroleum Corporation on September 14, 1952.

The new integrated facilities include a feed preparation section, a UOP Platforming Unit, a Udex Unit for aromatic extraction, and a fractionation section for the separation of the Udex extract into the finished benzene, toluene and xylene fraction, meeting nitration grade specifications.

The refinery processes a mixture of West Texas crudes totaling 30,000 barrels per day. The total straight run gasoline below 400 F. end point contained in the crude is first separated from the crude at the topping unit. The charge, which has a sulfur content of about 0.2 weight percent, is then processed in an existing clay treater for reduction of the sulfur content.

The first processing step in the new units is fractionation of the total straight run gasoline in a series of three towers for the purpose of preparing the individual naphtha fractions as feed for the Platforming Unit and stabilizing the light fraction of the straight run. The first tower in the feed preparation section is a depentanizer taking overhead the pentane and lighter fraction which is then sent to the light straight run stabilizer for depropanization. The bottoms from the depentanizer is then pumped to a charge splitter which separates the depentanized straight run into an overhead 150 to 270 F. fraction and a bottoms 270 to 400 F. fraction. The individual fractions are sent to intermediate floating roof storage from where they are charged to the Platforming unit.

In order to meet the dual requirement of producing high yield of aromatics and upgrading the heavy naphtha fraction for motor gasoline blending, the processing schedule was set up for a blocked-out operation on the Platforming unit.

On the alternate Platforming unit operating cycle for motor fuel production the unit is fed with the heavy naphtha cut of 270 to 400 F. boiling range. Balancing the motor fuel operation with the aromatic operation and consuming the available naphtha, the charge to the unit during the motor fuel operation has been approximately 3500 barrels per day. Operating conditions during the motor fuel operation have been controlled so as to produce a stabilized Platformate having a leaded F-1 octane number of 95 to 95.5. The yield of stabilized Platformate at this octane number level has been 94.5 to 95.5 volume percent of the charge.

When operating to produce aromatics for charging to the extraction unit, the Platforming unit is charged with the 150 to 270 F. prefractionated stock from storage. The processing conditions are set on the reaction section to favor maximum isomerization of the branched cyclopentanes to the corresponding cyclohexanes and dehydrogenation of the six membered ring hydrocarbons to the corresponding aromatics. The average charge rate during the aromatic operation to balance the time schedule on the blocked-out operation and to consume the available charge stock has been between 2000 to 2300 barrels per day. Tests made on the charge and product from this operation have shown the yield of total aromatics to be 94.5 percent of the aromatics present in the charge or producible from the naphthenes in the charge. This high yield has been maintained from the start of operation to date during the three priods of operation for aromatics production. Products from the reactor section are depentanized in the product stabilizer and then sent to the Udex unit charge tank.

The Udex unit is operated on a continuous basis charging the aromatic product from the Platforming unit. The charge rate is set to balance charge inventory and this rate to date has averaged 1600 barrels per day. The total hydrocarbon charge is introduced at a point approximately in the middle of the extractor. The hydrocarbon rising in the extractor is contacted in countercurrent manner with a descending flow of solvent which contains diethylene glycol. The solvent in contact with the feed extracts the benzene, toluene, xylene, and whatever heavier aromatics may be present. The paraffinic hydrocarbons in the feed leave the top of the extractor as raffinate. This material is blended with the refinery gasoline product stream.

The rich solvent leaves the base of the extractor and is fed to the stripper where the aromatics are separated as a net product. The stripped solvent completes its cycle when it is returned to the top of the extractor. The aromatic extract from the stripper is next fed to a system of fractionation for separation into the individual benzene, toluene, xylene and heavier aromatic fraction.

The fractionation of the total aromatic product into the individual aromatics, each meeting nitration grade specifications, is carried out in a series of three fractionating columns each of which is equipped with special instrumentation to precisely control fractionation, thereby avoiding the need for any additional fractionation on the individual product streams. The properties of the individual aromatics as currently produced from the unit are shown in Table 1.

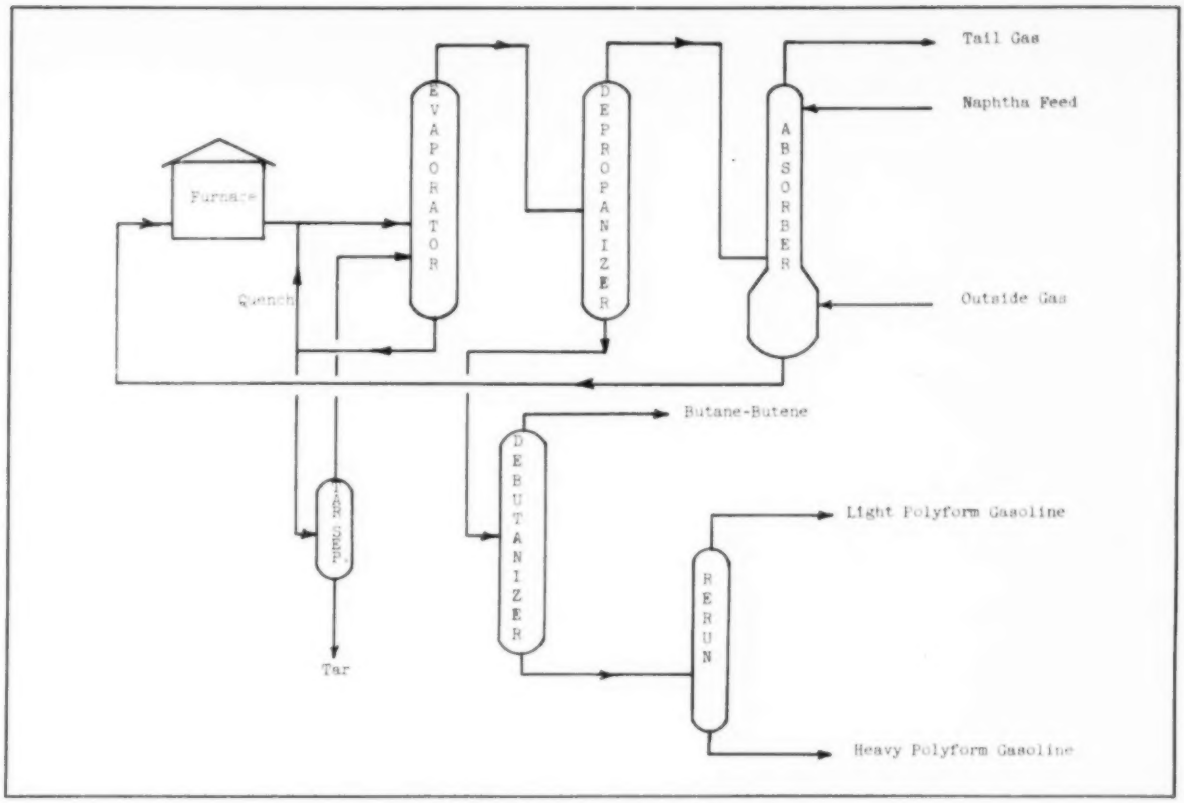


Figure 1. Flow diagram of a typical polyform unit.

Improve Polyform Operations With These Correlations

Substantial gains in capacity can be obtained by reducing dilution ratio.

R. C. Teitsworth
Magnolia Petroleum Company,
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SUBSTANTIAL increases in the capacity of polyform units can be obtained by increasing the percentage of naphtha in the furnace charge. A relationship (Figure 2) has been developed which relates the maximum allowable percentage of naphtha in the charge to the severity of operation. Development of this relationship and extension of its use to other processes are discussed in the following article.

Charge to the polyform furnace is composed of naphtha and light hydrocarbons which are mixed in the absorber (see Figure 1). The furnace effluent is discharged into a distillation system including evaporator, depropanizer, and gasoline rerun towers. Light and heavy polyform gasoline streams are produced having octane numbers of 83-93 and 80-92 (Research + 3 cc TEL), respectively. The light polyform gasoline is important to the refiner because of its high octane number. The low volatility (250-320 F. at 90 percent ASTM distillation point) minimizes costly undercutting of catalytic gasolines and permits upgrading of heavy catalytic naphthas into premium gasoline. Heavy polyform gasoline is rerun to reduce gum content subsequent to incorporation in regular grade gasoline.

The percentage of naphtha in the polyforming furnace charge is an important variable for unit control. This variable is expressed in terms of the dilution ratio. Dilution ratio is defined as the volumetric ratio of liquefied petroleum gas (LPG), i.e., butanes and lighter, to naphtha in the polyform furnace charge. The LPG is considered to be a diluent although a portion of it reacts in the furnace.

The major purpose of the LPG diluent in the polyforming process is to suppress coke formation. This allows the use of high cracking temperatures. Consequently, the gasoline product has a higher octane number than products from straight thermal reforming.

Polyforming is a result of two simultaneous but independent processes: reforming of naphtha and cracking of light hydrocarbon diluent. Operation at different dilution ratios has little or no effect on the octane number of the gasoline product at a given severity level. Furthermore, the reduction in gasoline yield accompany-

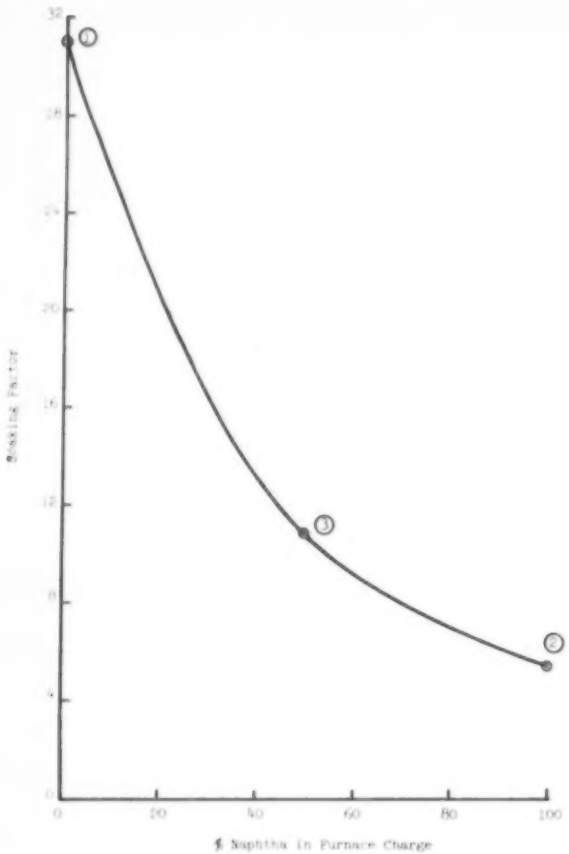

Figure 2. Relationship between soaking factor and dilution ratio.

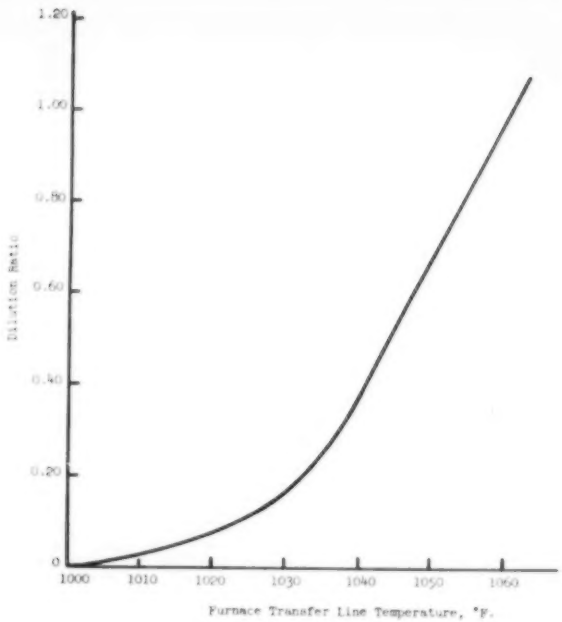

Figure 3. Relationship between dilution ratio and severity.

ing operation at low dilution ratio is of small magnitude. This reduction is a result of decreased conversion of the light hydrocarbon diluent to gasoline. The total yield of polyform gasoline is the sum of gasolines produced in the reforming and polymerization operations. The conversion of naphtha to reformate is substantially independent of dilution ratio. By lowering the dilution ratio, the circulation of LPG diluent is reduced and therefore the production of polymerization gasoline is somewhat decreased. Calculations and plant data indicate, for example, that a 2.1 percent yield differential (expressed as volume percent of naphtha in the furnace charge) exists between operations at 0.90 and 0.30 dilution ratio. This yield differential results from a loss in polymerization gasoline as indicated in Table 1.

TABLE 1
Effect of Dilution Ratio on Gasoline Yield From Light Hydrocarbon Diluent

Hydrocarbon	Composition of Furnace Charge Volume Percent	Estimated Conversion, Percent	Gasoline Yield, Percent of Conv.	Gasoline Yield, Vol. Percent of Naph.
@ 0.90 Dilution Ratio				
C_3	33.6	6	35	0.7
$=C_3$	3.8	100	55	2.1
C_4	2.5	22	47	0.3
$=C_4$	1.7	100	65	1.1
Total	....	....	....	4.2
@ 0.30 Dilution Ratio				
C_3	9.7	6	35	0.2
$=C_3$	2.0	100	55	1.1
C_4	4.6	22	47	0.5
$=C_4$	0.5	100	65	0.3
Total	....	....	....	2.1

Incremental Yield = 4.2 − 2.1 = 2.1 Volume Percent of Naphtha.

Increase in dilution above the level required for coke-free furnace operation is, therefore, not advantageous except as an expedient for cracking additional light hydrocarbon diluent.

Operation of the polyform process at reduced dilution ratios creates additional reforming capacity without equipment changes by minimizing the circulation of diluent hydrocarbons through the furnace. The extent to which dilution ratios may be reduced is limited by excessive coking in the furnace tubes. The rate of coke deposition is a function of the severity of cracking and the composition of the charge stock (or dilution ratio). For a charge stock containing light hydrocarbons, furnace severities may be comparatively high for coke-free operation. Conversely, furnace severities must be low for a charge stock which is easily cracked. In general, as the dilution ratio is reduced, tar concentration in the furnace effluent

TABLE 2
Plant Data for Polyforming at Various Dilution Ratios

Dilution Ratio	0.98	0.49	0.28	0.17
Furnace Outlet Temperature, °F.	1,050	1030	982	1030
Furnace Outlet Pressure, psi	1,140	980	1,180	970
Naphtha Charge Rate, B/D	9,490	12,600	14,470	16,000
Outside Gas Charge Rate, B/D	0	1,360	0	1,900
B-B Production, B/D	1,400	2,460	2,000	2,600
Lt. Poly Gaso. Production, B/D.	6,730	9,180	9,000	10,600
Hvy. Poly Gaso. Production, B/D	500	1,920	2,800	3,000
Octane Numbers (Res. + 3 cc TEL)				
Lt. Poly Gaso.	92.0	87.1	83.0	92.6
Total Poly Gaso.	90.0	86.6	78.0	91.8
Hvy. Poly Gaso.	88.2	79.0	67.0	89.6
Naphtha "K" Factor	12.18	12.15	12.18	11.86

increases. Therefore reduced severities must be used for coke-free operation.

For example, a gas dilution of zero is required for the relatively mild reactions involved in straight thermal reforming. An infinite gas dilution is necessary for the more severe operation of thermal polymerization. Intermediate gas dilutions are required in the polyform process where an intermediate cracking severity is employed.

This concept is applied to plant practice by use of Figure 2, which presents the relationship between soaking factor and dilution ratio (here expressed as percent naphtha in the furnace charge). The curve is defined by soaking factors for coke-free operating levels for thermal polymerization (Point 1), thermal reforming at 1000 F. furnace outlet temperature (Point 2), and polyforming (Point 3). The soaking factor for polyforming was calculated from design conditions for a typical unit (100 percent gas dilution, 1060 F. transfer line temperature). A more useful form of this relationship is shown in Figure 3, replotted using furnace outlet temperature. Thus, if a 1040 F. transfer line temperature is required to produce a product of specified octane number, the minimum dilution ratio for satisfactory operation is 0.37. The curve is conservative, particularly in the range of low transfer line temperatures, since it represents operation below the coking threshold. Some refiners have operated thermal reforming equipment (zero gas dilution) with transfer line temperatures as high as 1030 to 1040 F.

The usefulness of this concept has been confirmed by extensive plant data. Typical conditions for various operations are shown in Table 2. The dilution ratio of the charge has been varied from 0.90 to as low as 0.06. Corresponding increases in naphtha charge rate to the unit have ranged up to 81 percent at a severity level required to produce an octane number of approximately 89 (Research + 3 cc TEL) on the light gasoline product.

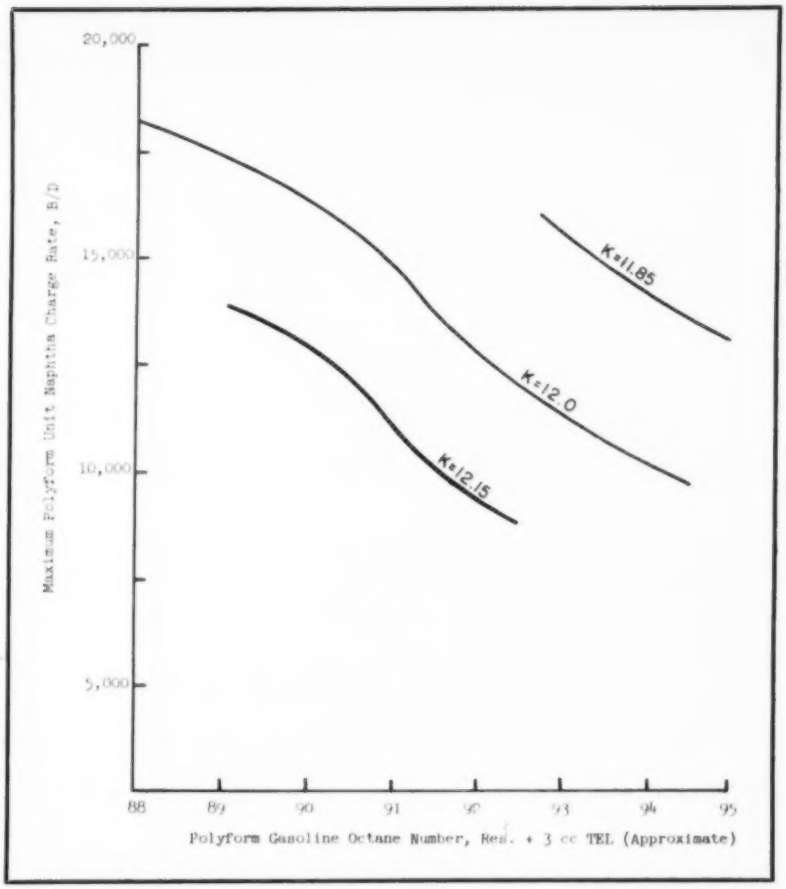

Figure 4. Effect of polyform gasoline octane number on maximum naphtha charge rate for a typical unit.

Figure 4 shows typical curves for polyforming capacity as a function of the octane number of light polyform gasoline at Beaumont.

The minimum operable dilution ratio can be estimated for other operations (such as gas oil polyforming) by use of Figure 5. Soaking factor is plotted as a function of the specific gravity of the furnace charge for several standard thermal operations:

1) Thermal polymerization of propane
2) Polyforming of 55° API naphtha at 1.00 dilution ratio
3) Thermal reforming of 55° API naphtha
4) Cracking of 25° API gas oil
5) Visbreaking of a 17.5° API residuum

The relationship in Figure 5 is based on two assumptions. First, soaking factors are for conservatively safe operations from the standpoint of coil coking. Second, tar production occurs from cracking only the heavier portion of the furnace charge. The formation of tar from the light hydrocarbon diluent in polyforming is small and can be neglected. Tar concentration (and coking tendency) in the furnace effluent is therefore proportional to the percentage of the heavy component in the charge. This is effectively expressed by the specific gravity of the charge. Use of Figure 5 is shown in Table A for polyforming kerosine (42° API) at various severity levels.

TABLE 3
Sample Calculation of Soaking Factor

Fraction of Coil Volume Above 800 °F.	Oil Temp., °F.	K_T/K_{800}	Press. psi	Press. Corr. $P_T/_{760}$	$P_T/_{760} \times K_T/K_{800}$	Simpson's Rule
0	800	1.0	1445	1.93	1.9 x 1	1.9
.1	855	4.8	1430	1.91	9.2 x 4	36.8
.2	905	18.2	1410	1.88	34.2 x 2	68.4
.3	950	54	1385	1.85	99.9 x 4	399.6
.4	990	140	1365	1.82	254.8 x 2	509.6
.5	1006	200	1340	1.79	358.0 x 4	1432.0
.6	1022	282	1315	1.75	493.5 x 2	987.0
.7	1036	381	1290	1.72	655.3 x 4	2621.2
.8	1046	470	1265	1.69	794.3 x 2	1588.6
.9	1054	556	1230	1.64	911.8 x 4	3647.2
1.0	1060	630	1200	1.60	1008.0 x 1	1008.0
						12300.3

$$F = \frac{\text{Coil Vol. Above 800 F.}}{\text{Rate B/D}} \times \frac{12300.3}{3 \times 10} = \frac{242 \times 12300.3}{9100 \times 3 \times 10} = 10.9$$

TABLE A

Soaking Factor	Approx. Furnace Outlet Temp., F.	Minimum Dilution Ratio
10	1055	1.35
8	1040	0.90
6	1010	0.64

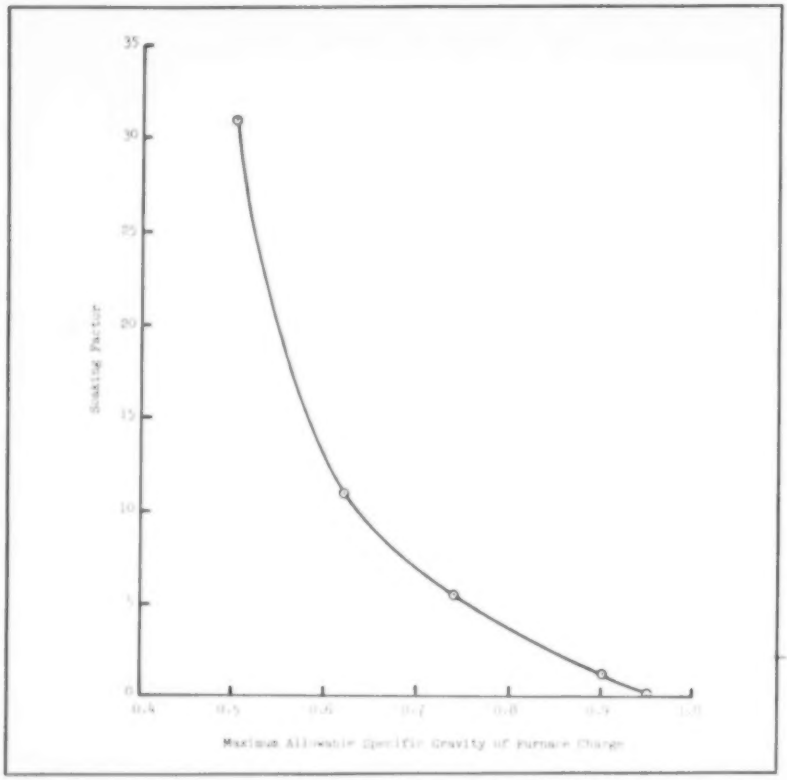

Figure 5. Relationship between soaking factor and maximum allowable specific gravity of the furnace charge.

The dilution ratio of the polyform furnace charge is an important variable in refinery operations. Selection of the optimum dilution ratio for polyform unit operations is dependent on:

1) Octane number requirements of finished gasoline streams.
2) Supply of tetraethyl lead.
3) Economics of additional reforming capacity vs. incremental polymerization of light hydrocarbons.
4) Availability of low grade naphthas or substitute charge stocks such as catalytic or virgin gas oils.
5) Coke-free operation of the polyform unit furnace as determined by the severity-dilution ratio relationship.

For optimum polyform unit operation, an evaluation of these factors must be made in order to determine the relationship between naphtha charge rate and octane number of the gasoline product. The frequency of these evaluations will increase the effectiveness of the polyform process in meeting shifting refinery gasoline blending requirements.

Calculation of Soaking Factor

A modified form of the first order reaction equation was used in calculating soaking factors. Standard reference conditions of 800 F. and 750 psi were used. The soaking factor equation was derived from Nelson.[1]

$$F^1 = \frac{C}{V} \times \frac{\text{Mean } K_T}{K_{800}}$$

where F^1 is the soaking factor referred to 800 F.

C is the coil volume above 800 F. in cubic feet.

V is the thruput in barrels daily.

K_T, K_{800} are reaction velocity constants.

The term Mean K_T/K_{800} is evaluated over the heating curve by integration. The effect of pressure on residence time is approximated by the operating pressure divided by the reference pressure. This assumption is reasonably accurate since, under standard reforming conditions, compressibility effect is negligible. The effect of temperature on fluid density has been neglected since a narrow range of temperatures (1000-1060 F.) was investigated. The soaking factor equation is then given by:

$$F = \frac{C}{V} \int_0^1 \frac{P_T}{750} \times \frac{K_T}{K_{800}} \times dz$$

where F is the soaking factor referred to 800 F. and 750 psi

$\frac{P_T}{750}$ is the pressure correction factor

Z is the fractional coil volume above 800 F.

The soaking factor equation can be easily solved by graphical integration or by use of Simpson's rule.[2] Data for the relative reaction rate (K_T/K_{800}) have been presented by Hirsch, Crawford, and Holloway.[3] These data were used in calculating soaking factors for gas oil cracking and thermal polymerization as well as for reforming. Soaking factors were thereby kept on a comparable basis. A sample calculation showing the application of Simpson's rule is shown in Table 3.

ACKNOWLEDGMENT

The author wishes to express his appreciation to Magnolia Petroleum Company for permission to publish the manuscript and to V. A. Kalichevsky for his assistance and encouragement.

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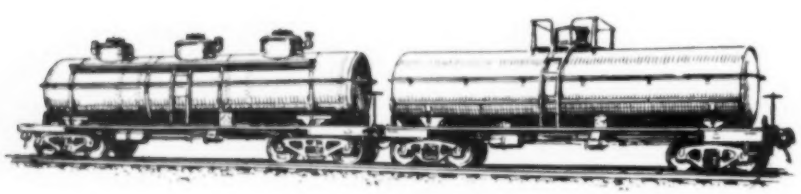
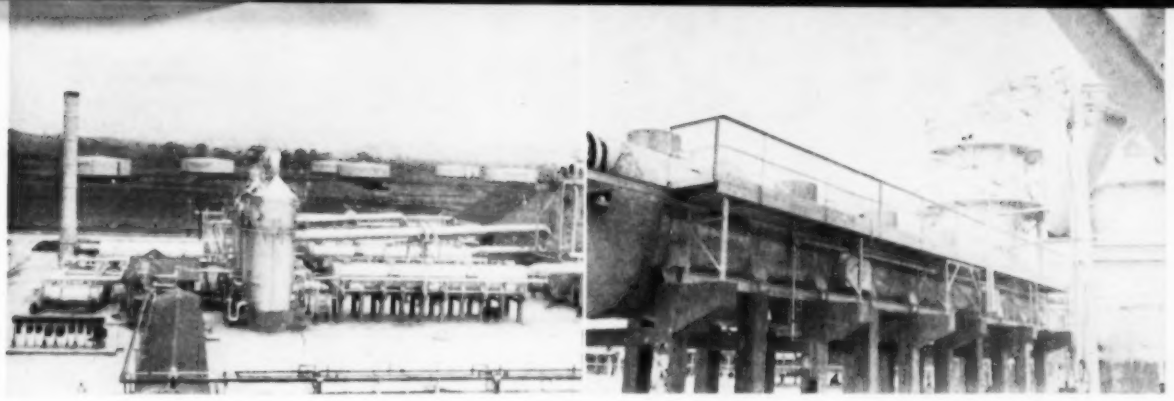
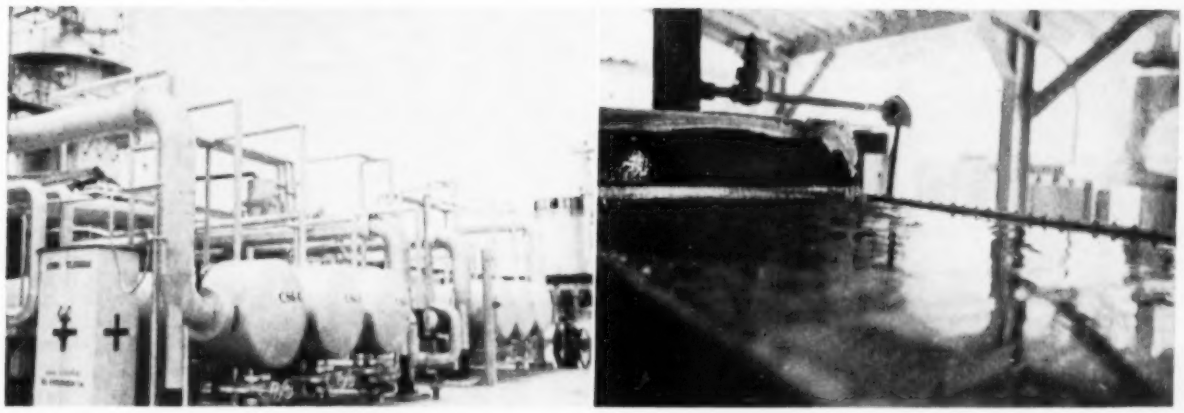




Plant view where tail gases from furnace . . .

. . . enter this converter and condensed sulfur . . .

Mexico's Sulfur Recovery Plant Ranks . . . . Second Largest in the World



. . . passes through these coolers . . .

. . . accumulates as molten sulfur . . .

(See next page)

Seymour Schwartz
S. Schwartz & Associates, New York

THE WORLD'S second largest sulfur recovery plant, operated by Petroleos Mexicanos at Poza Rica, recovers 120 tons per day to make the Republic of Mexico a net exporter instead of importer of sulfur.

Sour natural gas from the Poza Rica field is brought in from the field through a series of compressors which feed two amine-type purification plants. Consisting of two mirror-image units each designed for 60 million cubic feet of sour gas per day, the plant currently treats sufficient sour gas to process a total of 85 million cubic feet daily. The sulfur-recovery plant operates at the capacity of the Girdler units to furnish waste acid gas.

Currently feed to the plant is shown in Table 1.

The "B" stream acid gas, along with sufficient air to burn the H_2S to SO_2 and the hydrocarbons to CO_2 and water, are fed through a special ring-type burner located at one end of a "dog-house" or Dutch-oven at the furnace inlet. Combustion of the gases proceeds as follows:

$$H_2S + 3/2\,O_2 = H_2O + SO_2 \qquad (1)$$

$$CH_4 + 2O_2 = 2\,H_2O + CO_2 \qquad (2)$$

Combustion products in the Dutch oven enter the forepart of the furnace proper, a vertical cylindrical vessel containing a central checkerwork baffle wall. Here the "A" stream is fed along with the remaining stochiometric quantity of air. The combined combustion products from the "A" and "B" streams pass through the checkerwork baffle and down through the afterpart of the furnace and out the opposite end. Sufficient hydrogen sulfide is left unburned in order to carry out the final reaction in the catalytic converters:

$$2\,H_2S + SO_2 = 2\,H_2O + 3S \qquad (3)$$

Sufficient total air is fed to the furnace to provide a 2/1 volume ratio of H_2S to SO_2 in the tail gases to effect maximum conversion to sulfur.

The gases leave the furnace at about 1330 F. Approximately 92 percent of the furnace effluent stream enters the waste heat boiler, also of special design, the balance being by-passed for reheating the condenser exit gas at a later stage in the process.

The boiler consists of two vertical bundles of finned tubes in a steel cas-

TABLE 1

	"A" Stream	"B" Stream
Flow, std. cu. meters/hr.	15,700	4,200
Percent H_2S	16.3	19.9
Percent CO_2	80.0	74.1
Percent Hydrocarbon	.2	2.5
Percent H_2O	3.5	3.5
Air flow, std. cu. meters/hr.	15,000	

. . . solidifies on this conveyor belt . . .

. . . discharges from this breaker.

ing lined with refractory. An internal by-pass arrangement allows the boiler exit gas temperature to be controlled within desired limits ranging to about 480 F. Approximately 26,000 pounds per hour of 250-psig steam is generated.

Boiler exit gases enter one end of the No. 1 converter, a horizontal cylindrical vessel ten feet in diameter by 65 feet long containing a layer of alumina catalyst. The gases pass downward through the bed and exit at the opposite end. In doing so further sulfur formation occurs, according to Equation (3), and the reacted products leave at about 550 F.

The No. 1 converter exit gas stream is divided and fed to two condensers operating in parallel wherein the entire gas stream is cooled to 265 F. The vessels are 16 feet in diameter by approximately 45 feet tall, packed with subway grating. The hot gases are cooled by pumping cool molten sulfur from a central pump pit through heat exchangers and then to the top of the condensers. The liquid sulfur falls countercurrent to the rising stream of gas and sulfur vapor. While in contact with the packing, direct-contact heat exchange occurs between the gas and the liquid which causes the effluent liquid sulfur stream to become heated, and sulfur vapor in the gas to condense out as product.

The use of direct-contact sulfur reflux, considered normal in the petroleum industry, is unique in sulfur recovery operation in that it provides efficient heat removal as well as collection of sulfur mist formed when sulfur vapor is cooled.

The gases leaving the No. 1 condensers are reheated to 374 F. by mixing it with the hot furnace effluent stream mentioned previously. The combined gas stream enters a No. 2 converter, similar in appearance and construction to the No. 1 vessel, and also containing a bed of alumina catalyst. Reaction in this vessel raises the effluent temperature to 410 F.

The gases next flow into the No. 2 condensers similar to the No. 1 vessels, wherein cooling by recycled molten sulfur occurs, the condensate forming part of the effluent liquid stream and appearing as product in the collecting pit. At this point approximately 93.5 percent of the input hydrogen sulfide is converted to sulfur.

The gases which exit the No. 2 condensers flow into two parallel-connected mist extractor vessels approximately ten feet in diameter by 45 feet long. These contain beds of spray removal packing which remove uncondensed sulfur spray prior to the next process step. In this, the gases are reheated to about 700 F. with combustion products from an externally fired natural gas furnace. The combined products are passed through a catalyst bed wherein destruction of the unreacted hydrogen sulfide occurs. Effluent products from the oxidizer, consisting of about .4 percent SO_2 and about .07 percent H_2S together with inert gases and water vapor, are vented to the atmosphere through a 100-foot stack.

The liquid sulfur streams which leave the condensers return to the pump pit and overflow to a central storage pit, a reinforced concrete tank set below ground level which also serves as an emergency storage.

The sulfur pumps deliver approximately 3000 gpm of sulfur through two banks of three serially-connected shell and tube exchangers. Each exchanger contains approximately 2000 square feet of surface. Approximately 326,000 pounds per hour of feed water is pumped through these exchangers at 196 F. to remove the heat picked up by the recycled sulfur. This water furnishes the town's central power plant with boiler feed water. A complete system of controls and alarms are provided to take care of all fluctuations and changes in plant operation so that a balanced water system results at all times.

Part of the cooled sulfur is fed to a continuous water-bed-supported stainless steel belt approximately 30 inches wide by about 134 feet long. Solidification of the molten sulfur by air and water cooling results in a continuous ribbon of sulfur. This is broken up into free-flowing chips of sulfur approximately five sixteenths of an inch thick by four inches on a side. This method of sulfur handling is unique among all sulfur plants and avoids the need for the conventional pouring into huge forms and blasting. It is also a very economic method of sulfur handling and requires negligible operating labor.

Chip sulfur is stored in an elevated hopper to facilitate truck loading and shipment. However, part of the broken product may be stockpiled on an adjacent areaway. A small pad is available for storing in block form, however, to provide for emergency storage.

The production of this plant is approximately 120 short tons per day. The ultimate capacity of the plant has never been determined, due to the fact that the gas treaters presently operate at capacity. Individual tests on various pieces of equipment, however, indicate that the plant will recover 160-180 tons per day with but negligible changes in the existing equipment.

Several unique features of this plant deserve special comment. In the family of sulfur recovery units, in general, this plant recovers high purity sulfur of 99.9 percent or better from the weakest acid gas strength known to be so treated. The production rate is second largest in the world, second only to Texas Gulf's Worland plant which processes a 56 percent acid gas and produces about 300 tons of sulfur per day. The plant avoids dangerous and expensive sulfur blasting and yet produces an easily handled solid sulfur product.

This single plant has changed the entire sulfur economy of the Republic of Mexico from one of dependence on the United States to one of independent operation under Mexican control.

The sulfur recovery plant was constructed by Arthur G. McKee Company, Cleveland, Ohio. Process designs, technical and economic studies were by S. Schwartz & Associate in collaboration with the Allied Chemical & Dye Corporation, New York.

Thermal Insulation For Industrial Requirements

Part X. This final installment defines the needs and progress toward standardization and highlights some educational shortcomings.

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STANDARDIZATION is the process of reducing a volume of data or collection of facts to a state or condition wherein they can be evaluated with like results. It is the purpose of this article to assist in developing a better understanding of the need for thermal insulation standards to exercise control in the use of thermal insulants, in the use of test methods for thermal insulants, and in the consistant application of the results obtained by those test methods.

The benefits to be derived from standardization are manifold. The first effect is an orderly systematic procedure. The second is the versatility of material uses which will evolve into an application pattern easily adapted to the required conditions. Finally, each improvement in the applied technique, concerning either materials or methods, produces a corresponding increase in the service life of the applied materials. This is particularly important when, in times of rising costs, economics become increasingly significant.

Standardization and Low Bids

Standardization, since it results in a more sound basis on which to evaluate and compare, can be quite beneficial for example, in adoption of the lowest bid policy. Without an adequate basis for comparison of information which should be considered, adoption of this policy is not infrequently proven to be false economy and thus unwise procedure.

There is a great opportunity for progress in the insulation industry through increasing productivity of those now occupied in its work and training additional scientists and engineers for this field.

An integrated standardization program can assist in accomplishing the first, and the second can be accomplished through cooperation of industry and the institutions of learning.

Changing conditions, which are exacting in their demand for availability of materials, impose a responsibility on leaders of industry. This has created a desire to conform to a coordinated plan that make available, materials which can be used to create many combinations of like or unlike materials. An outstanding example of such a method is now transforming the thermal insulation industry into a cohesive organization not heretofore realized.

Following the completion of a large construction operation during early 1935, several carloads of surplus thermal insulating materials were listed on the inventory records. The author was requested to devise some method of eliminating such surplus volumes on future operations. This resulted in a study which in the fall of that year, brought into being the *Thomas Dimensional Standards* for thermal pipe insulation. Through this medium any combination of hot with hot materials, cold with cold materials or hot with cold materials may be used.

This system is based on manufacturing all pipe insulation to a common outside diameter which conforms to a standard pipe of that size. All pipe insulation so manufactured can be nested so that shipping and storage space may be conserved and best of all the flexibility of handling and application has never before been approached. Approximately 75 percent of the sizes and thickness existing before this method was put into effect can eventually be eliminated. Most manufacturers are now producing or have in process of development, equipment for manufacturing these materials and they should be available soon.

It was through the American Society for Testing Materials that a program was established which ultimately received its impetus through acceptance by the producer, consumer and general interest groups. This society has for its purpose the promotion of knowledge of the materials of engineering, and the standardization of specifications and the methods of testing. Before a standard, covering any commodity, is adopted by the society, it must be generally accepted and approved by the manufacturers interested in that type of product, the consumers who use the material and those members who have an interest in but who cannot classify under the first two headings. This latter group consists of members of experimental laboratories, fire underwriters, etc. These standards must be reviewed at least every two or three years and may be acted upon at lesser intervals when sufficient evidence has been presented to justify consideration.

Years are sometimes required before a standard is identified by number, because, much research must often be resorted to before all parties concerned will agree to its submission to the society. Competent consumers' representatives should inquire about the work of Committee C-16 on thermal insulating materials with a view toward contributing to its activities since every user of such material, no matter how small, benefits from the results obtained by this group of men.

Recognition to Groups

In discussing sources of standards, recognition should also be given to the work done by such organizations as the American Standards Association, U. S. Bureau of Standards, U. S. Navy and a limited number of industrial companies. Specifications presented as standards are sometimes furnished by manufacturers either directly or through their associations. These specifications necessarily written for a specific type of product, are seldom coordinated to permit evaluation of competitive materials of similar type. It is therefore practically impossible for the general practicing engineer to make a proper selection from bids received from a number of independent sources. Haphazard or incomplete information can be extremely costly when used for bidding purposes. Thermal insulation specifications are too seldom specific enough to require close adherence to them and are too frequently so wide open that the contractor can do about as he chooses. This may or may not be desirable. A realization by industry of the inordinate costs of heat conservation in their plants will demand surveys in

increasing number which will ultimately require as much care in the designing for conservation of heat as is now established for the production of the heat involved.

As a pioneer in the highly specialized field of industrial insulation, a sense of pride would seem to be justified in the realization that so much progress has been revealed through the efforts of such a small number of contributors during the past 15 years. Still, so much of a fundamental nature remains to be done, that the accomplishments thus far are merely the beginning.

Two Research Programs

Two such fundamental research programs which should have been undertaken long ago are now in progress: 1) effect of moisture on thermal conductivity and 2) the moisture vapor resistance of thermal insulating materials with their weather and vapor components. Without this information the insulation design engineer is greatly handicapped, since every atmospheric and sub-zero installation is subject to these conditions and they must be recognized as factors in a properly designed job. This knowledge will enable the insulation specialist to predict the service life of a particular application within a reasonably accurate length of time.

Standardization is to some extent a censorship. It stands to reason therefore, that the standardization of any method should meet with the approval of as large a representation of those interested as possible. All progressive and productive projects must include standard procedures if they are to obtain the greatest benefits from their operations. The preceding nine articles of this series are predicated upon a systematic adherence to better service through improved facilities. As previously stated, a phenomenal reduction is effected in materials alone and application is likewise simplified by handling uniform materials at all times. However, the technical and paper work involved in the preparation and execution of a job is too often almost overwhelming, but by the adoption of standards, production per man has been tripled within recent years and strangely enough interest in the work has increased rather than diminished, proving that simplification need not necessarily result in dull routine.

Standardization to some, unfortunately, means holding on to antiquated methods without thought or study for present requirements. Much is written to perpetuate such ideas particularly as they refer to specific types or brands of materials. Of course, some overenthusiastic proponents of a new development may lean far in the opposite direction. The acceptance of either antiquated or untested information must be tempered to the individual users own needs.

The insulation engineer must be able to discern when overemphasis of certain properties may tend to draw attention from the weak points. This is where the insulation specialist plays such an important role. His training and background enable him to detect omissions and discrepancies and thus to request information pertinent to any thermal insulation problem.

When it is realized that some problems may require the consideration of nearly 200 separate items, it can readily be appreciated that an ill advised solution could be costly indeed. So much thermal insulation information is of necessity empirical, that the use of all the known data requires in addition a great deal of knowledge based on experience in performance.

Facts, therefore, must play an important role in judging the merits of any material and its application. Any material will give results to a certain degree, but is that degree great enough to satisfy the service desired? The thermal insulation engineer is therefore indispensable in even the ordinary job when two or more materials may be used for the service involved. It can well be stated at this point that the cost of thermal insulation, which varies from two percent to ten percent of the total cost of a job, is frequently greater than the cost of the item on which it is applied.

Faulty Liaison

The dissemination of information concerning the thermal insulation industry is of ever increasing importance. Good standards occurring in the publications of organizations mentioned elsewhere in this article are of paramount importance. There is another phase however which is too frequently neglected, that of interpretation. It is a rarity to find a clear understanding prevalent in the field forces. And this is no reflection on the personnel concerned with the physical application. It is rather an inherent weakness in the liaison between the design engineer and the mechanic.

The author has been duly concerned for many years with the weakness of this link, and has at last, it is believed, found an answer. The inability to obtain field information during many years while working in the technical branches of the industry, caused this condition to swell in its relative importance far beyond its normal status. A survey of existing organizations indicated that a psychological as well as a physical structure was needed to fill this gap.

Every existing group, large or small, stemmed from technical, engineering or association interests. No place was open to the field mechanic who aspired to improve himself and his trade, to the purchasing agent who desired to better acquaint himself with the products he was required to buy, or to the plant maintenance forces that seldom had contact with those who could convey information concerning the latest developments and methods.

Insulation Group Organized

To fill this void, the author initiated the formation of the Thermal Insulation Society in 1949. The purpose of this organization is to bring together those persons interested in thermal insulation; to accumulate and aid in the exchange of information both for the mutual benefit of those concerned and as a public service; and to endeavor at all times to advance the science of thermal insulation. The value derived by those taking part has been demonstrated through the consistent attendance and increased participation. The goal of this society includes a continuous educational program, and the promotion of better standards and application. It is hoped that this organization will eventually be a source for information not now readily available.

Where are our thermal insulation engineers to come from? The aspiring student now has no place to go for his technical education in our institutions of learning except to work as a technical assistant or to use thermal insulation as a subject for his thesis toward a degree.

The author should like, as a personal contribution, to propose that engineering schools make provision in their curriculum to create a course of study which will provide duly accredited graduates to fill the ever increasing demand for qualified thermal insulation engineers. It may be created as an elective to be sought out by the graduate student, or it may be included in the regular study of any of the established engineering curriculums. It may indeed merit a chair dedicated to a course in "Thermal Insulation Engineering."

It would be difficult indeed for industry to justify an investment to better advantage, than the creation of scholarships or fellowships to provide this specialized training, so vitally needed, to deserving students.

End of Part X and series.

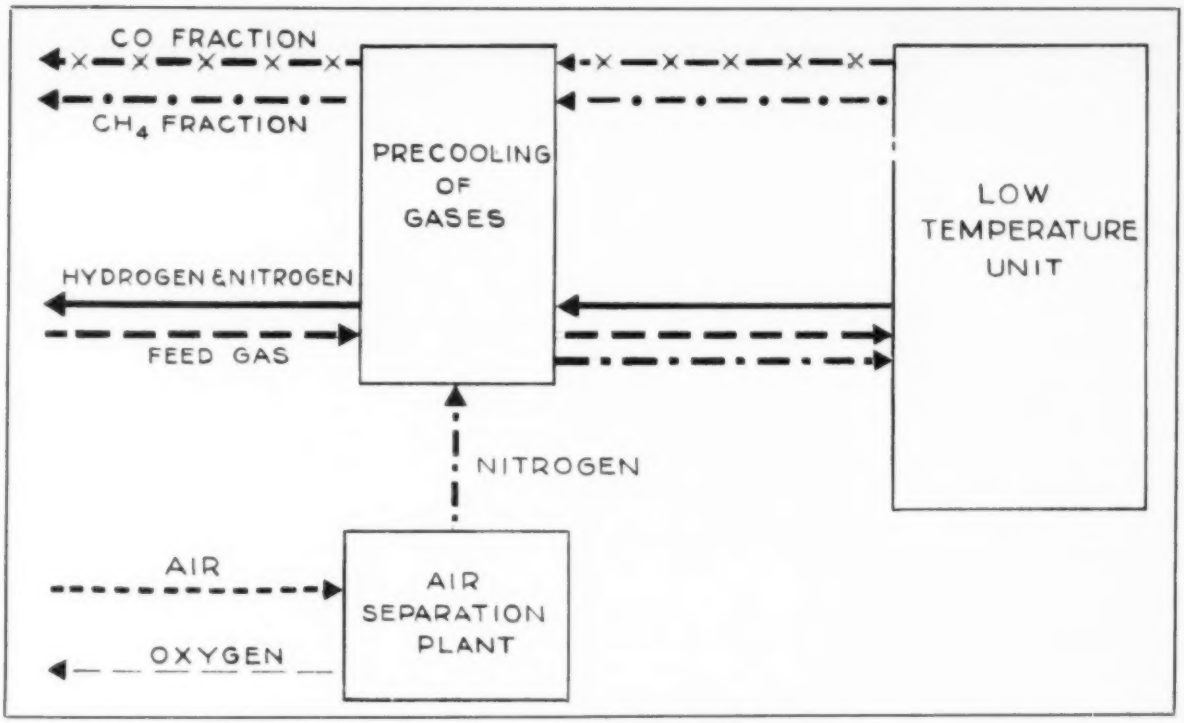

Figure 1. Ammonia synthesis gas production.

Producing Ammonia Synthesis Gas

Low temperature nitrogen washing process can also produce 98 percent hydrogen

J. S. Bardin and D. W. Beery
Chemical Plants Division Blaw-Knox Company, Pittsburgh

WITH THE LARGE expansion in synthetic ammonia capacity which is now under way,[2] there is increasing interest in the final purification of hydrogen-rich gas streams. The problem is to remove impurities such as carbon oxides, argon, oxygen, and hydrocarbons from the hydrogen. The carbon oxides are particularly undesirable since they poison the ammonia catalyst[6] and also may form ammonia carbonates and carbamates in the converter system and lines.[4]

Since methane is inert so far as the ammonia synthesis is concerned, it does not poison the catalyst. However, it must be removed from the conversion cycle because otherwise it will build up and reduce the effective partial pressure of the hydrogen and nitrogen. A portion of the methane dissolves in the liquid ammonia product; the remainder must be purged from the system.[3] This results in loss of ammonia product as well as synthesis gas.

Conventional processes frequently used are removal of the hydrocarbons by scrubbing with a light oil and carbon monoxide removal by scrubbing with a refrigerated copper ammonium formate solution.[6] Catalytic conversion of the residual carbon monoxide to methane is also used for final purification in high pressure ammonia synthesis plants.[5]

However, neither of these methods removes methane. There is a definite trend to the use of liquid nitrogen wash systems for the final purification of ammonia synthesis gas in the plants now being constructed. The synthesis gas from a liquid nitrogen wash plant contains a very low quantity of inerts and catalyst poisoners, which results in high conversion to ammonia and good catalyst life.

The increased use of nitrogen wash systems is apparently due to the recent shift from natural gas reforming as a source of feed gas to two other sources of synthesis gas: 1) the partial oxidation of natural gases to produce a hydrogen-rich feed gas, and 2) the direct use of hydrogen-rich refinery gases. The partial oxidation of natural gas[1] (which is carried out with oxygen from an air separation plant) leads to the use of the nitrogen wash system for purification of the synthesis gas, since large quantities of nitrogen are available as a by-product from the air separation plant. Where refinery gases are used as a feed source, the liquid nitrogen wash system effectively removes not only carbon monoxide but also

Original presentation as "Application of Low-Temperature Processes to Hydrogen-Rich Gases" was at the Oklahoma State AIChE meeting, Tulsa Section, October 11, 1952, Tulsa.

TABLE 1

Nitrogen Wash Gas Balance (Typical Refinery Gas—CO Free)*

COMPONENT	Feed Gas Percent	C_3-C_4 Percent	C_2 Percent	C_1 Percent	N_2-C_1 Percent	H_2-N_2 Percent
H_2	78.00		2.4	5.1	8.0	75.0
N_2					33.3	25.0
C_1	11.34		25.2	93.6	58.7	
C_2	7.80	5.5	70.4	1.3		
C_3	2.62	86.3	1.9			
C_4	0.24	8.2	0.1			
Total	100.00	100.0	100.0	100.0	100.00	100.0
Quantity scfm	100.00	2.8	10.7	6.5	4.4	103.0

* Pure N_2 required = 22 scfm per 100 scfm of feed gas.

TABLE 2

Nitrogen Wash Gas Balance (Typical Refinery Gas Mixture)*

COMPONENT	Feed Gas Percent	C_2 Percent	CH_4 Percent	C_4-C_3 Percent	CO-N_2 Percent	H_2-N_2 Percent
H_2	60.74	1.8	3.7		5.0	75.0
N_2	10.06	0.3	19.7		68.4	25.0
CO	3.35	0.1	6.4		16.0	
CH_4	21.16	23.9	69.7		10.6	
C_2H_4	0.74	15.0	0.5	0.9		
C_2H_6	2.80	57.6		4.3		
C_3	1.10	1.2		90.7		
C_4	0.05	0.1		4.1		
Total	100.00	100.0	100.0	100.0	100.0	100.0
Quantity scfm	100.00	4.6	22.25	1.15	10.0	79.0

* Pure N_2 required = 22 scfm per 100 scfm of feed gas.

methane while the above mentioned copper ammonium formate solution cannot remove methane.

Since most refinery gases contain appreciable amounts of methane, the advantages of the liquid nitrogen wash system are evident. This process has been proven commercially in the United States and has been used extensively in Europe. This article will review the application of low temperature nitrogen washing as developed by the German Linde Company (The Gesellschaft fuer Linde's Eismaschinen A. G., Munich, Germany) to hydrogen-rich gases not only for the production of ammonia synthesis gas ($3\ H_2$-N_2) but also for the production of streams containing over 98 percent hydrogen.

Description of Process

Figure 1 shows a block diagram for a liquid nitrogen wash plant to purify a hydrogen-rich gas. First, high purity nitrogen is produced by an air separation unit and compressed to approximately 3000 psig. The high-pressure nitrogen and the hydrogen-rich gas, at 150-300 psig, are passed through a pre-cooling unit. Here, the entering streams are first cooled by the gases returning from the low temperature unit. The feed gas is then dried so that the water quantity reaching the low temperature unit is minimized. The feed gas and the nitrogen are further cooled to —50 F. using conventional refrigeration equipment. The last step is important since otherwise this cooling would have to be done by the low temperature nitrogen cycle used in the nitrogen wash system. If the refrigeration to —50 F. were eliminated and all of the cooling were done with the nitrogen refrigeration cycle, the total power requirement would be much greater than that of the system shown. This system, which reduces the temperature differences between the medium being cooled and the refrigerant, avoids a greater increase in entropy for the system which means greater irreversibility and lower overall efficiency.

The low-temperature unit is shown in Figure 2. Feed gas at —50 F. flows through two exchangers where it is cooled to —290 F. by the returning hydrogen-nitrogen stream. The cold feed gas then enters the bottom of the methane condenser where the gas is cooled to —310 F. and methane is condensed by the evaporating carbon monoxide fraction from the bottom of the nitrogen wash column. The overhead stream from the methane condenser enters the bottom of the nitrogen wash column. At this point the gas still contains objectionable quantities of carbon monoxide and other compounds which are scrubbed out by liquid nitrogen fed to the top of the column. The overhead from the nitrogen wash column consists of approximately 85-95 percent hydrogen and 5-15 percent nitrogen together with traces of carbon monoxide and oxygen. Some additional nitrogen is blended with the overhead stream to balance heat duties on the feed gas coolers. The hydrogen-nitrogen stream first is warmed by the feed gas and is then split: one part is warmed further by the feed gas and the other part is warmed by the high-pressure nitrogen at 3000 psig. The hydrogen-nitrogen streams unite and leave the low temperature unit at approximately —50 F. The methane fraction is throttled as it leaves the methane condenser and is warmed by high pressure nitrogen in two of the nitrogen coolers. The bottoms from the nitrogen wash column consisting of nitrogen, carbon monoxide and methane are throttled and evaporated in the methane condenser and then are warmed in the same two exchangers as the methane fraction. Both streams leave the low-temperature unit at approximately —50 F.

High-pressure nitrogen at approximately 3000 psig enters the low-temperature unit at —50 F. The nitrogen feed stream is split: part of it is cooled by the hydrogen-nitrogen mixture and part of it is cooled by the methane and carbon monoxide fractions. The two nitrogen streams are then brought together and cooled to —290 F. by the methane and carbon monoxide fractions. A portion of the cold nitrogen is throttled and mixed with the overhead stream from the nitrogen wash column, thereby balancing heat duties in the unit. The remaining cold nitrogen is throttled and passes through a coil in the methane condenser where it is liquefied and then fed to the top of the nitrogen wash column. The additional nitrogen necessary for a 25 percent concentration in the ammonia synthesis gas is added to the hydrogen-nitrogen mixture outside of the low-temperature unit.

Discussion of the Process

The first example considered is the treatment of a gas obtained by partial oxidation of natural gas followed by shift conversion and carbon dioxide removal steps. A typical gas so produced contains 96 percent hydrogen, 3 percent carbon monoxide and 1 percent methane. In this case, virtually no liquid fraction is obtained from the methane condenser, but the carbon monoxide and methane are almost completely scrubbed out in the nitrogen wash column. Composition of the bottoms from the column is 17.3 percent methane, 52.0 percent carbon monoxide, 22.5 percent nitrogen and 8.2 percent hydrogen.

The overhead from the wash column contains approximately 95 percent hydrogen and 5 percent carbon monoxide as was mentioned previously. The quantity of contaminants contained in this mixture after the final amount of nitrogen has been added will be of the order of 10 ppm of oxygen, 5 ppm of carbon monoxide and 3 ppm of argon. It should be mentioned that the amount of argon and oxygen present is influenced by the quantities of these contaminants in the nitrogen used. This is apparent when it is considered that a portion of the nitrogen required for a 3:1 ammonia synthesis gas mixture is added external to the cold box and consequently the amount of oxygen and argon contained in the final synthesis gas will be a direct function of that contained in the nitrogen.

The scope of this paper does not include the familiar low temperature

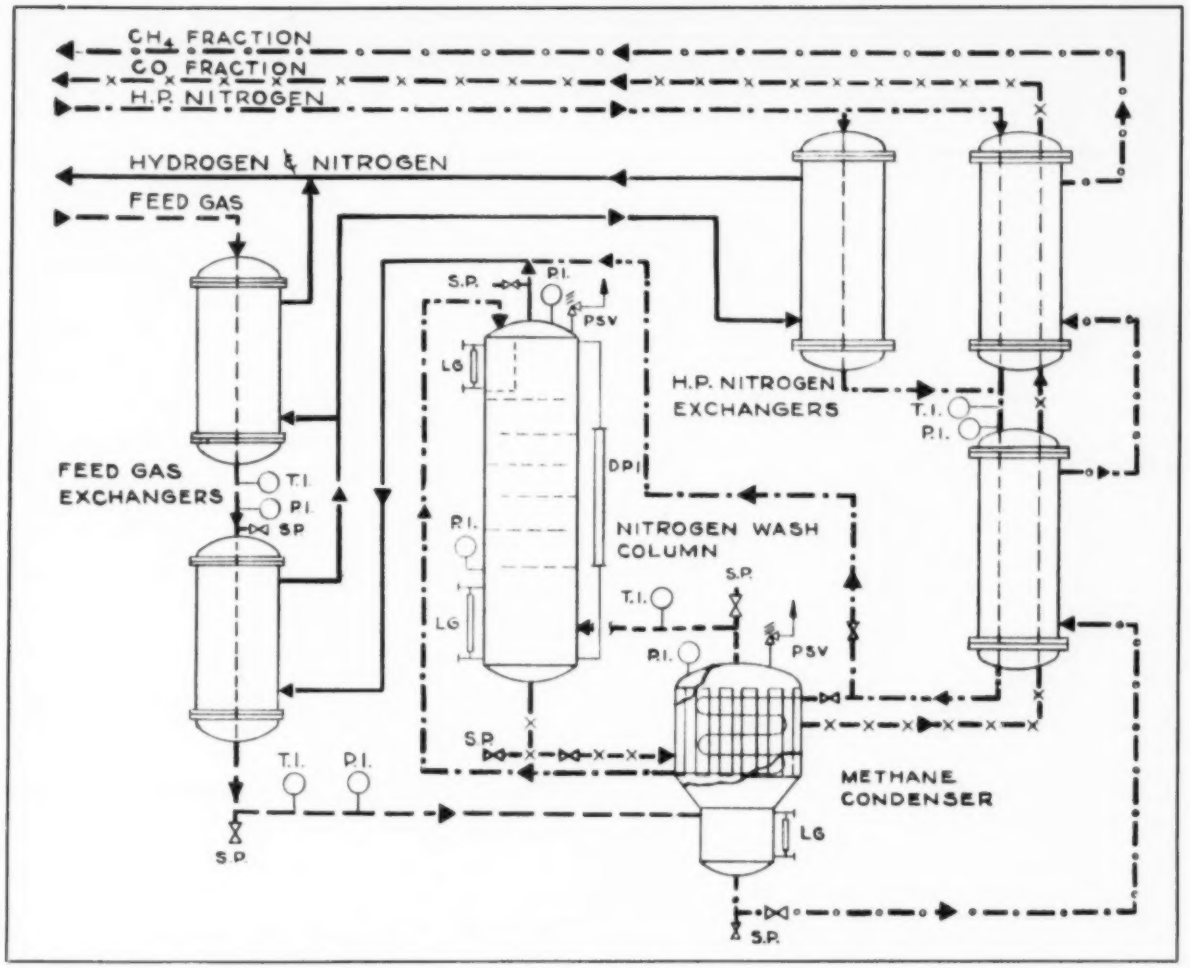

Figure 2. Liquid nitrogen wash system.

process for nitrogen separation from air. It is sufficient to state here that large scale commercial operation has shown the feasibility of producing nitrogen containing less than 0.005 percent argon and oxygen combined. While this amounts to 50 ppm maximum, it represents only 15-20 ppm based on the final synthesis gas. The type of air separation plant used for nitrogen production affects the nitrogen purity greatly and the argon and oxygen content of the nitrogen may at times vary from the above value depending upon the type of plant selected.

Continuing with the example, 36.2 cubic feet of nitrogen are required for 100 cubic feet of feed gas; 31.4 cubic feet appear in the 3:1 ammonia synthesis gas while the remaining 4.8 cubic feet are discharged from the bottom of the scrubbing column as part of the carbon monoxide fraction. For this particular feed gas, 60 percent of the nitrogen is compressed to approximately 3000 pounds while the remainder is compressed to 300 psig, the operating pressure of the system. From each 100 cubic feet of feed gas, 125.6 cubic feet of ammonia synthesis gas are obtained. The hydrogen recovery is better than 93 percent.

It should be noted that if more methane is in the feed gas than in the present case, a significant portion will be liquefied in the methane condenser and at the same time more carbon monoxide will be removed at this point due to its solubility in the methane. However, it will still be necessary to remove final traces of carbon monoxide and methane in the scrubbing column.

A plant of this type based on treating a gas of the stated composition and pressure in sufficient quantity to produce 200 tons per day of ammonia synthesis gas has been estimated to cost approximately $1 million complete including the necessary compressor building of transite construction. This figure, of course, only includes the nitrogen wash system and does not cover the cost of the air separation plant.

As can be seen from the basic process, the major utility is power for the nitrogen compressor and the conventional refrigeration unit. For a plant to produce 200 tons per day of ammonia the following utilities are required: Power—1630 kw and cooling water (85 F.-15 F. rise) 1158 gpm. These figures reduce to 202 kw and 8330 gallons of water per ton of ammonia synthesis gas produced.

The process which has been described is generally applicable to a wide variety of gas compositions when suitable modification of the heat exchange scheme is made. If the feed gas contains larger quantities of methane and/or C_2 and C_3 hydrocarbons, there will be a greater quantity of condensate, and provisions must be made for draining and re-evaporating the various fractions at appropriate points. The hydrocarbon fractions can be discharged from the plant as either gases or liquids. If liquid streams are withdrawn, the low temperature refrigeration requirements will increase.

Figure 3 shows a gas balance when

feeding a typical refinery gas to the nitrogen wash plant. It should be noted that the C_3 and C_4 fraction contains approximately 86 percent of C_3 and 8 percent of C_4. This particular fraction, although originally obtained by a partial condensation, has been partly freed of C_2 in a column. If a greater purity is required for these recovered fractions, they can be further cleaned up separately. This gas balance is based on an operating pressure of 225 psig, and the hydrogen recovery is slightly better than 99 percent.

Since there are appreciable quantities of C_2 and C_3 hydrocarbons in the feed gas and since it is desired to withdraw the C_3 and C_4 fraction as a liquid, the normal external refrigeration is replaced by means of a methane refrigeration cycle. The advantage of this cycle becomes apparent when it is considered that, in order to condense the C_2, C_3 and C_4 components, the refrigeration must be available at a temperature level lower than that obtainable with ammonia or freon. However, in order to maintain as advantageous an entropy level as possible for the entire system, it is much cheaper from an operational standpoint to remove the latent heat of vaporization of the C_2, C_3 and C_4 hydrocarbon quantity present by means of methane refrigeration instead of nitrogen refrigeration. When using a methane refrigerating cycle for auxiliary cooling in place of the more generally used refrigerants, some additional heat exchange surface is required. On the other hand, because of the lower temperature level reached by methane, it is necessary to compress the nitrogen only to 425 psia in order to liquefy it.

The above gas is stated to be free of carbon monoxide. However, it is very doubtful that any refinery gases are free of carbon monoxide to the extent that they would not contaminate the ammonia synthesis catalyst. For this reason the gas is scrubbed with liquid nitrogen for the removal of any traces of carbon monoxide as well as for the final removal of methane.

Table 2 shows the gas balance for a plant to operate at 175 psig treating a typical refinery gas mixture containing a considerable quantity of carbon monoxide and methane. Again the C_2 and C_4 components are to be recovered in a liquid state. However, the plant uses conventional auxiliary refrigeration and is of the same basic design as that shown in Figure 2, typical liquid nitrogen wash system. However, liquid nitrogen instead of column bottoms is evaporated in the methane condenser. The reduced quantity of ethylene and ethane present does not justify the use of a methane refrigeration cycle. From the information shown it is apparent that even though much of the carbon monoxide is removed in the methane fraction, approximately 57 percent of it remains in the gas as it enters the nitrogen wash column and must be removed by liquid nitrogen scrubbing.

It is interesting to note that in the previous gas which contained no nitrogen, 27.4 cubic feet of nitrogen were required per 100 cubic feet of feed gas, while the gas presently being discussed requires only 22 cubic feet of nitrogen for each 100 cubic feet of feed gas. This varying requirement results because of the different percentage of hydrogen present in the two feed gases (78 percent and 60.74 percent hydrogen in the respective cases) and not because of the greater percentage of nitrogen (over 10 percent) present in the latter gas. Actually, the nitrogen required per 100 cubic feet of hydrogen present in the feed gas is 35.1 cubic feet in the former case and 36.2 cubic feet in the latter. The additional nitrogen for the second case is lost from the bottom of the column in scrubbing out the carbon monoxide present in this gas.

It can be seen from these examples that it is difficult to generalize regarding nitrogen wash systems. Since the basic process is a very flexible one, the flow scheme must be tailored to the specific requirements of each operation. However, the above should serve in a general way to illustrate the potentialities of this system for purifying ammonia synthesis gas.

If desired, hydrogen of over 98 percent purity can be produced from any of the feed gases mentioned by simply feeding the overhead from the nitrogen wash column to a condenser cooled by means of liquid nitrogen boiling at less than 2 psi absolute.

Thus, the liquid nitrogen is cooled to very near its triple point of —346 F., the lowest temperature which can be conveniently secured with nitrogen. There is no danger of the nitrogen freezing, since trace impurities are always present, so that the freezing point is depressed sufficiently to assure safe operation. At this minimum practical temperature, the optimum operating pressure for the production of over 98 percent hydrogen is roughly 225 psia. If the pressure of the gas is either raised or lowered, the equilibrium hydrogen concentration decreases. The product stream from the condenser contains less than 2 percent nitrogen with somewhat fewer contaminants than given above for the ammonia synthesis gas. The nitrogen requirements in this case are greatly reduced since the hydrogen is no longer diluted with nitrogen for feed to the ammonia synthesis. In the event that carbon monoxide and traces of methane are not objected to in the hydrogen, the nitrogen wash column could be eliminated and only the condenser would be used. Ninety-eight percent hydrogen would still be produced, but roughly two-thirds of the diluent gas would be carbon monoxide and one-third would be nitrogen.

By way of interest a nitrogen wash plant to produce 98-percent hydrogen-2 percent nitrogen in a quantity equivalent to 200 tons per day of ammonia (35.3 tons per day of hydrogen) would cost $965,000. This figure compares with $1 million previously given for a plant to produce 200 tons per day of ammonia from a gas consisting of 96-percent hydrogen, 3-percent carbon monoxide and 1-percent methane. The hydrogen plant is not appreciably cheaper than the ammonia synthesis gas plant even though a smaller capacity nitrogen compressor is used since this reduction is substantially off-set by the increased cost due to the additional reflux condenser and the vacuum pump.

The required power and cooling water for this system will be approximately 1000 kw and 700 gpm.

Summary

Currently there is considerable interest in the use of liquid nitrogen wash systems for the final purification of ammonia synthesis gas. The process is a very flexible one with extremely wide applicability and can be used not only for ammonia synthesis gas purification but also for producing streams containing 98 percent hydrogen or better. The purified synthesis gas is delivered from the plant at close to entering pressure. Not only does nitrogen scrubbing remove carbon monoxide which poisons the ammonia synthesis catalyst but also it condenses the bulk of any methane present, thereby reducing the purge stream after the synthesis. A few of its applications to various hydrogen-rich gas streams have been outlined to show the broad utility of this technique. Attention has been called to the possibilities for the separate recovery of valuable gas components other than hydrogen. Approximate investment figures and utility requirements have been given.

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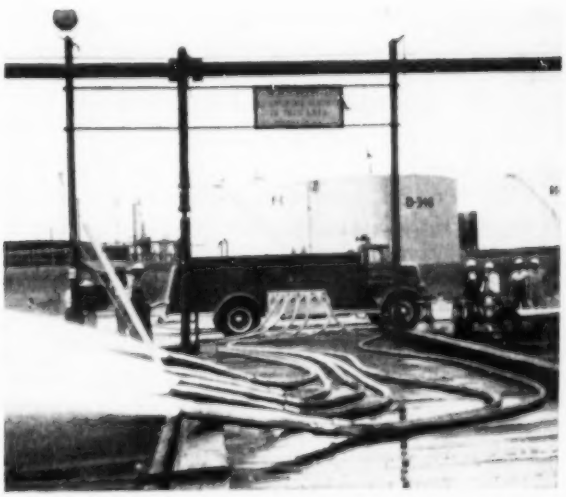
LESS EQUIPMENT and fewer men are required to fight fires at Shell Oil Company's Houston refinery since the recent addition of these three "foam houses on wheels." The trailer and each of the trucks hold 900 gallons of foam liquid and each unit is equipped with its own foam tower, hose, nozzles, and other necessary equipment. Water is fed to the units through six 2½-inch inlets at the rear of the units, then mixed with 3 percent liquid foam and ejected through six discharge connections on either side. The mixing is accomplished in the trailer with a proportioner powered by a gasoline motor. Proportioners in the trucks are powered by the truck motors. One of the trucks is also equipped with a 600-gallon water pump which works off the truck motor. Three units are needed for maximum efficiency because most of the larger tanks have three foam chambers.

Shell Combats Fires With Less Manpower and Equipment

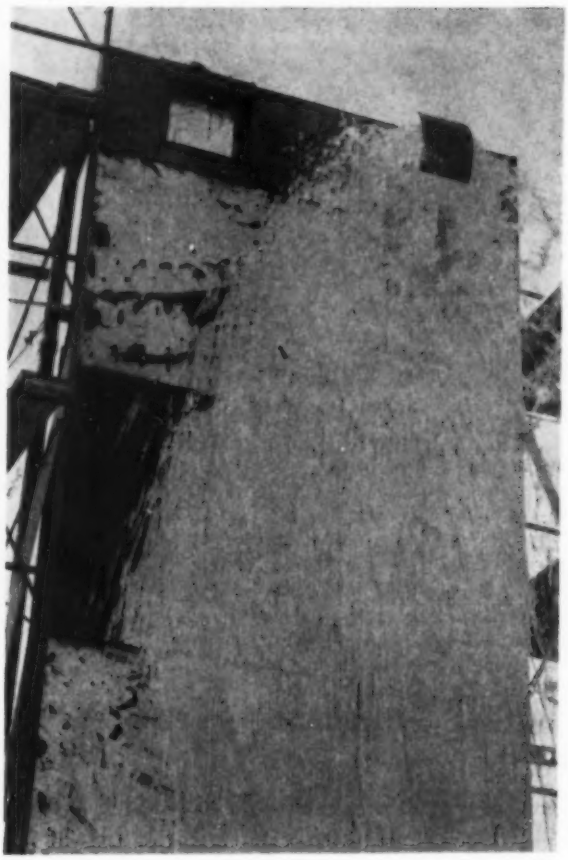
Fire-fighting technique at Houston refinery acquires greater mobility with recent addition of three foam houses on wheels

WHEN FOAM is discharged instead of water, as here, the mixture leaving the trucks or trailer is fed air through injectors on each of the nozzles.



CLOSEUP OF a foam truck in action. This illustrates the ease of operation of the individual hose streams, which carry 125 pounds per square inch pressure and throw about 125 gallons per minute.

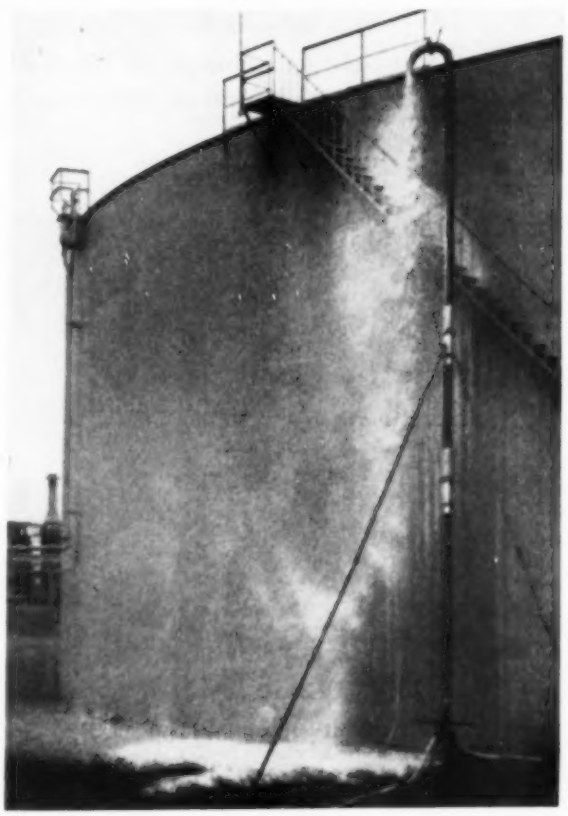
(Also see next page)



THE FOAM is poured upon tank fires by the Moeller tube, splash and tower methods. The Moeller tube is provided on the larger tanks to insure a gentle application of the foam to the oil surface, thereby conserving foam production for the faster coverage of the larger surface areas on the big tanks. The foam is fed into the tube (upper left) through a pipe leading into the foam chamber. The chamber is fitted with a diaphragm which is shoved inwards under pressure from the foam. Air is injected just before the liquid foam enters the foam chamber.

THE SPLASH system is shown in operation in photo at upper right. Diaphragm for the Moeller tube is at the left of the picture.

THE FOAM tower or applicator system (right) is used on floating roof tanks or on tanks having no foam chambers or damaged foam chambers. A goose-necked pipe is connected at the top end of the applicator. The air injector is located at the flange on the base of the goose neck. This foam tower has been converted from chemical powder service to mechanical foam production. To left of photo is a typical foam chamber with Moeller tube, which is scheduled to be converted to mechanical foam service.



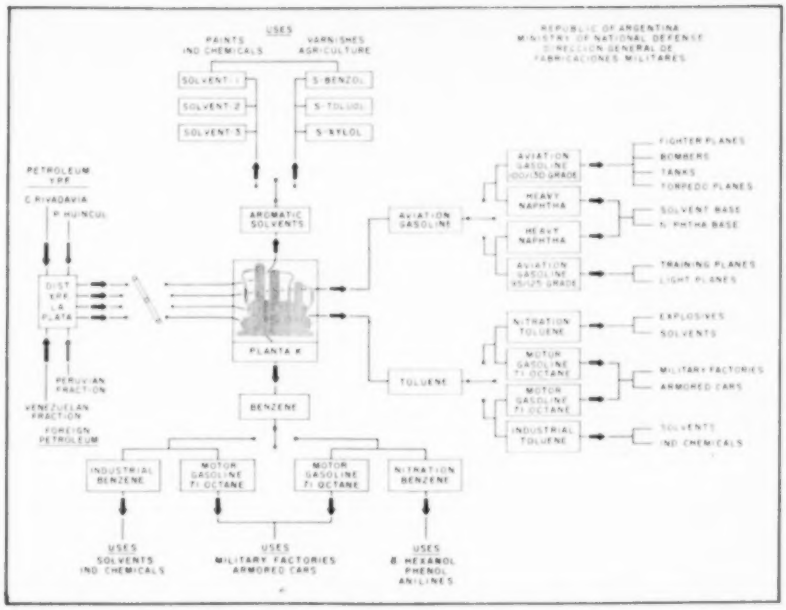


Figure 1. Schematic diagram of new hydroforming and aromatics recovery facilities.

New Hydroforming Unit Produces Petrochemicals and AvGas

New Argentina aromatics facilities completely described with . . . Flow Diagrams . . . Operating Conditions . . . Complete Analyses

J. J. Swift, S. R. Stiles, E. W. Howard and M. Tarnpoll
The M. W. Kellogg Company, New York

THE SUCCESSFUL operation of the Hydroforming and aromatics extraction plant recently completed for the Argentine government marks an important step in their far-reaching program of self-sufficiency and industrial development. This Hydroforming and aromatics extraction plant is the only one of its kind in the world outside of the United States.

The project was conceived and constructed by the Dirección General de Fabricaciones Militares (DGFM) for the primary purpose of manufacturing nitration grade toluene. The plant was designed by the M. W. Kellogg Company while construction and operating assistance was supplied by its Latin-American subsidiary Kellogg Pan American Corporation. Although the plant was originally designed for producing nitration grade toluene, it has also, since the start of operation on April 26, 1951, successfully accomplished the production of nitration grade benzene, and finished aviation gasoline of 91/98 and 100/130 grades. The flexible operation of this plant is accelerating the industrial development program of the government in related fields. Figure 1 shows the significance of the Planta K in the Argentine industrial picture.

Hydroforming process design has undergone considerable development since its introduction some 12 years ago. Practical considerations of desired capacity, capital expenditure and local conditions peculiar to the project, dictated the final design of the Hydroformer for this project as a fixed bed unit having two catalytic reactors, and following the basic design of many previous Hydroforming units. The aromatics recovery system, wherein the pure aromatic is extracted from the crude aromatic concentrate from the hydroforming operation uses the phenol extraction principle.

The plant was heated up and naphtha was cut into the first reactor on April 26, 1951 in an operation on a narrow-boiling C_7 naphtha fraction for the production of toluene. The initial operation of the plant was concerned primarily with the training of the plant operating personnel, proving of equipment, and the development of the operating conditions leading to the test runs. The performance test runs were begun on May 26, 1951, and all contractual guarantees were completely fulfilled and approved by May 31, 1951, at which time the plant was considered officially approved and accepted by the DGFM.

The plant operation has been eminently successful from the outset, and the actual performance has exceeded by considerable margins all design guarantees with respect to the yields, quality of products and utilities consumption. With the exception of several interruptions due to power failures and a short shutdown necessitated by the catalyst changing in one reactor, Planta K has been in continuous opration for more than one year since its initial start-up.

Prior to the initiation of the process design, considerable Hydroforming pilot plant studies and analytical work were carried out to establish the basic factors of the design for the feed stocks which were contemplated being used by the DGFM. The basic laboratory work was directed primarly to the production of toluene using narrow-boiling C_7 fractions from Comodoro Rivadavia and Challaco crude oils which are native to Argentina. On the basis of the pilot plant work the guarantees for the plant were established at a minimum yield of 35 weight percent nitration grade toluene to be obtained from a feed stock having the specifications shown in Table 1.

TABLE 1

Design Feed Stock Inspections

Specific Gravity	0.742
ASTM Distillation:	
Initial Boiling Point	95.0 C.
5 Percent	97.2
10 Percent	97.2
20 Percent	97.7
30 Percent	97.7
40 Percent	97.7
50 Percent	97.7
60 Percent	98.3
70 Percent	98.3
80 Percent	99.0
90 Percent	99.5
95 Percent	100.0
End point	113.5
Percent Recovery	99.0
Residue	0.7
Vol. Percent Kattwinkel	13.3
Mol. Percent Olefines	1.4
Vol. Percent Aromatics (From Kattwinkel)	11.9
Vol. Percent Naphthenes	46.9
Molecular Weight	96

The specified distillation range includes whatever content in the crude oil there may be of; a) methylcyclohexane, b) ethylcyclopentane, and c) normal heptane. The richer the methylcyclohexane content of the charge stock, the greater the potential toluene yield, since methylcyclohexane is most readily converted to toluene. Ethylcyclopentane is the next most desirable component for toluene manufacture.

Because of local difficulties precluding the possibility of obtaining feed stock from the Challaco crude source, a new narrow-boiling range C_7 fraction obtained from Comodoro Rivadavia crude was taken as the feed stock for the toluene operation. In view of the different nature of the actual feed stock, the yield guarantees for the operation were revised to reflect the changed feed stock composition as compared to the design feed. The comparison of the actual feed and design feed with the corresponding yield guarantees is shown in Table 2.

TABLE 2
Comparison of Design and Actual Feed Stocks

	Design Feed	Actual Feed
Specific Gravity	0.742	0.7346
ASTM Distillation:		
Initial Boiling Point	95.0 C.	97.6 C.
5 Percent	97.2	98.3
10 Percent	97.2	98.7
20 Percent	97.7	99.0
30 Percent	97.7	99.2
40 Percent	97.7	99.5
50 Percent	97.7	99.8
60 Percent	98.3	100.2
70 Percent	98.3	100.7
80 Percent	99.0	101.5
90 Percent	99.5	102.7
95 Percent	100.0	104.2
Dry Point		106.6
End Point	113.5	
Vol. Percent Paraffins	39.8	55.95
Mol. Percent Olefines	1.4	6.73
Vol. Percent Aromatics	11.9	2.77
Vol. Percent Naphthenes	46.9	34.65
Nitration Grade Toluenes:		
Guarantee Yield	35.0 Wt. Percent	19.3 Wt. Percent

The operation of the plant showed characteristic yields for the toluene operation as set forth in Table 3.

TABLE 3

	Corrected Yields (Output Basis)
Gas	11.0 Wt. Percent
Light Naphtha	50.5 Wt. Percent
Heavy Naphtha	5.0 Wt. Percent
Polymer	1.8 Wt. Percent
Nitration Grade Toluene	31.4 Wt. Percent
Coke	0.3 Wt. Percent
Total	100.0 Wt. Percent

Because of a lack of instruments, at the time, to permit the measurement of quantities leading to the calculation of coke production on the catalyst, the figure of 0.3 weight percent coke included in the yield figures has been assumed the same as the coke figure used in the design calculations.

The yield of nitration grade toluene obtained exceeded the guarantee yield for the actual feed stock. Also this observed yield (on an output basis) is 90 percent of the guarantee yield which was contemplated for the design feed stock having a composition considerably superior to the feed stock used in the actual operation.

The inspections of the products resulting from toluene operation may be exemplified by the composite average of the products obtained during the test run, as shown in Table 4.

TABLE 4
Analyses of Hydroformer Product

	Raw Concentrate From Hydroformer (Feed to Extraction)	Light Naphtha	Heavy Naphtha	Toluene
Specific Gravity	0.7717	0.7104	0.9033	0.8716
ASTM Distillation:				
IBP—°C.	94.5	43.0	140.0	110.3
5 Percent	98.0	52.0	141.5	110.4
10 Percent	99.0	61.5	142.0	110.4
20 Percent	100.5	76.8	143.5	110.5
30 Percent	100.6	82.5	145.0	110.5
40 Percent	101.3	86.2	148.0	110.6
50 Percent	102.2	88.8	151.0	110.6
60 Percent	102.3	91.2	158.0	110.6
70 Percent	103.3	93.3	168.0	110.6
80 Percent	104.6	95.5	228.5	110.6
90 Percent	106.9	98.4	260.0	110.6
95 Percent	108.8	102.3	278.5	110.6
Dry Point	114.3	104.0		110.8
End Point	....	....	300.0	....
Vol. Percent:				
Olefines	4.8	8.6	....	....
Aromatics	47.2	14.4	....	100.0
Paraffins	48.0	77.0	....	....
Kattwinkel	....	....	100.0	....
Octane No.:				
CFRM	....	60	....	....
CFRR	....	65	80-90	....

The quality of the toluene produced in Planta K is considerably superior to the specification requirements for nitration grade toluene, as shown in Table 5.

TABLE 5

	Nitration Grade Toluene (ASTM Specifications)	Nitration Grade Toluene (Planta K)
Specific Gravity	0.8690 to 0.8730	0.8716
Color	Not darker than solution of 0.003 grams $K_2Cr_2O_7$ in 1 liter H_2O.	Lighter
Total Distillation Range	Not more than 1 C. including the temp. of 110.6 C. ±0.1 C.	0.5 C.(110.3 C.-110.8 C.)
Acid Wash Color	Not darker than No. 2 Color Standard	—1
Acidity	No free acid.	None
Sulfur Compounds	Free of H_2S & SO_2.	Free
Copper Corrosion	Copper strip shall show no irridescence nor a gray or black discoloration.	Negative
Paraffins	Not more than 1.5 vol. percent.	0

The production of toluene from Planta K, as indicated in the above comparison, of a quality better than specification, is obtained at the expense of yield and it is conceded that producing toluene just meeting the ASTM specifications would result in an increased toluene yield.

The light naphtha produced in the toluene operation is a mixture of the light naphtha obtained from the first fractionator tower in the Hydroformer recovery system and the light naphtha from the overhead of the phenol recovery tower following the extractive distillation. The quality of this light naphtha, therefore, is a function primarily of the efficiency of the extraction process since any unextracted aromatic will be found in this light naphtha. This product is being used as a motor gasoline by the DGFM and shows a lead susceptibility such that the octane number is raised from 60 CFRM-clear to 81 CFRM with 3.0 cc's tel. The heavy naphtha, which is a polymer product obtained from the bottom of the second fractionator tower above the aromatic concentrate cut, is rich in xylenes. This heavy naphtha product, because of its rich aromatic content, is disposed of in great part by sale to a refinery where it is used for solvent production. Some of the heavy naphtha is rerun to gasoline end point and because of its high octane value, is blended directly into motor gasoline production.

The toluene operation settled out smoothly in a 40-hour total reactor cycle time in which the breakdown of functional times are approximately as follows:

Reaction	20 hrs.	0 min.
Recycle Gas Purge		15 min.
Depressure		15 min.
Coke burning	16 hrs.	30 min.
Reheat	1 hr.	30 min.
Catalyst pretreat	1 hr.	
Repressure		30 min.
TOTAL	40 hrs.	

Following approximately three months in toluene operation, the unit in continuous stream was switched by change of operating conditions to a benzene operation using a narrow-boiling range C_6 fraction derived from Comodoro Rivadavia crude oil. Unfortunately, only a six-day supply of C_6 feed stock was available. This interim operation was considered to be merely an exploratory run to establish desirable operating conditions for production of benzene.

The feed stock used in the operation in general had the characteristics shown in Table 6.

TABLE 6
Benzene Feed Stock Inspections

C_6 Feed Stock:	
Specific Gravity	0.7015
ASTM Distillation:	
IBP— C.	66.7
10 Percent	74.0
50 Percent	75.0
90 Percent	80.0
End Print	82.3
Volume Percent Aromatics	5.0
Volume Percent Naphthenes	63.7

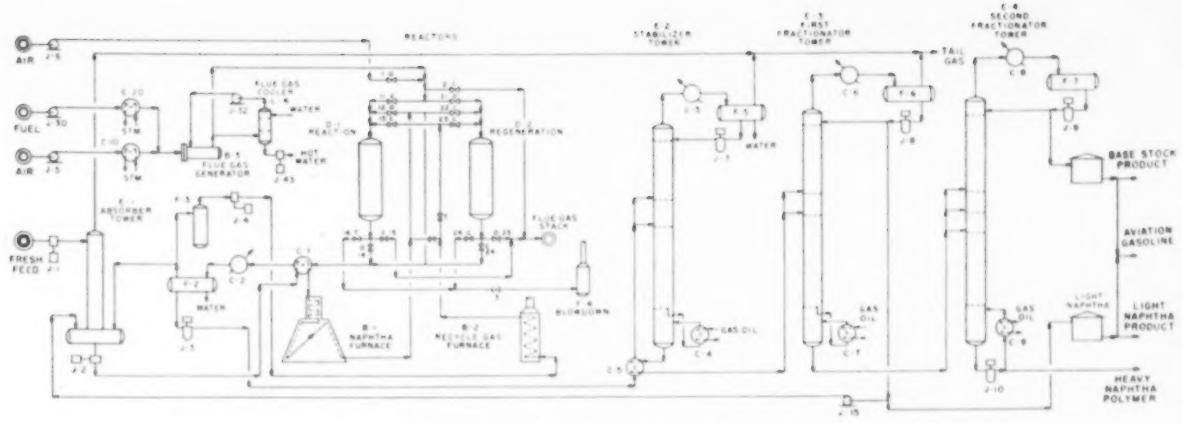


Figure 2. Process flow sequence for aviation gasoline manufacture.

This distillation range includes whatever content in the crude there may be of cyclohexane and methylcyclopentane. The cyclohexane is the preferred feed stock for benzene manufacture in conventional Hydroforming equipment, while methylcyclopentane is a less desirable component.

This exploratory benzene run yielded a nitration grade benzene of superior quality to that required by ASTM specifications as indicated by the comparison in Table 7.

TABLE 7.
Analyses of Finished Benzene Product

	Nitration Grade Benzene (ASTM Specifications)	Nitration Grade Benzene (Planta K)
Specific Gravity	0.8820 to 0.8860	0.8829
Color	Not darker than a solution of 0.003 grams $K_2Cr_2O_7$ in 1 liter H_2O.	Lighter
Total Dist. Range	Not more than 1 C. including the temperature of 80.1 C.	0.8 C. (79.7 C.-80.5 C.)
Solidifying Point	Not lower than 4.85 C. (anhydrous basis)	5.1 C.
Acid Wash Color	Not darker than No. 2 Color Standard.	−1
Acidity	No evidence of acidity.	None
Sulfur Compounds	Free of H_2S and SO_2.	Free
Copper Corrosion	Copper strip shall show no irridescence nor a gray or black deposit or discoloration.	Negative

Because of the short duration of this run, no yield data are available to show the extent of conversion to benzene obtained in the operation. However, the results obtained, from visual observation, are extremely satisfactory. It is planned to operate again for benzene production at a later date, following the completion of the aviation gasoline program at which time it is expected that the C_6 naphtha feed stock will be available in adequate supply.

Upon the completion of the interim benzene operation, attention was directed to the possibility of producing 100/130 grade aviation gasoline from Planta K. Argentina was, to a major extent, dependent upon imports for aviation gasoline, and the local situation at the time dictated the need for a native production of the 100/130 grade gasoline. This goal was achieved with notable success.

The function of the Hydroforming operation in the aviation gasoline picture in the past has been devoted primarily to the production of an aromatic base stock, which is then blended with other aviation components. Considering Planta K in this regard, the potentialities of the Hydroforming and fractionation section for aviation gasoline production were felt to fall into two categories:

a) Production of 93-160 C. aviation base stock which would then require blending with alkylate or isooctane and isopentane to produce the finished aviation gasoline;
b) The production of a complete finished 100/130 grade aviation gasoline directly from the fractionation section of the plant.

A complete gasoline could be produced by selective blending of the light naphtha and aromatic base stock, produced in individual towers in the fractionation system, to meet the volatility specifications of the aviation gasoline.

The phenol extractive distillation system was shut down and, as shown in Figure 2, the Hydroformer fractionation system was adapted for the aviation operation. The stabilizer tower is used for control of the front end volatility, the first fractionator tower is used to produce a light naphtha cut overhead of approximately 93 C. endpoint, while the second fractionator tower produces a base stock overhead of approximately 160 C. endpoint and a heavy naphtha polymer from the bottom. A recycle of light naphtha is circulated from the reflux drum of the first fractionator overhead to the absorber tower accumulator drum where the recycle is mixed with the entering fresh feed to constitute the total charge to the catalyst reactors.

The stabilized net light naphtha product from the overhead of the first fractionator and the base stock from the overhead of the second fractionator are selectively blended to meet the volatility specifications of the aviation gasoline desired. This blended gasoline is then leaded with the maximum permissible concentration of tetraethyllead to produce the finished 100/130 grade aviation gasoline. Using the United States Government specifications for 100/130 grade aviation gasoline as a criterion, the finished gasoline so produced is approved as satisfactory and acceptable for use by the Argentine Ministry of Defense.

The performance ratings for the Planta K aviation gasoline are determined officially by the standard F-3 and F-4 rating machines located at an air base laboratory. These performance ratings indicate a number of 100 for the F-3 test and a number in excess of 130 for the F-4 test. It was found initially that the F-4 performance number could be varied, within the limitations imposed by vapor pressure and volatility specifications, by adjustment of the ratio between the light naphtha and base stock used in the blend. With a change in operating conditions, and by this same method of selective blending of the aviation components, there is produced also very readily 91/98 grade gasoline and 95/125 grade gasoline which are also acceptable for use by the Ministry of Defense, again using U. S. government specifications as criteria for these respective gasolines.

The fresh feed charge to the aviation gasoline operation is a light naphtha derived from an Oficina crude oil.

Because of the problems attendant to its supply, the composition of the feed is not constant, but in general the feed stock charge to the Hydroforming operation has an ASTM boiling range of 30 to 150 C. with 45 volume percent distilling at 100 C. and contains approximately 14 volume percent aromatics and 30 volume percent naphthenes.

Since the Planta K Hydroformer is designed primarily for aromatics production using a narrow-boiling feed, the operation for aviation gasoline production using a wider boiling range feed stock finds its capacity limitation dictated by the capacity of the catalyst coke burning facilities. This capacity factor has influenced the use of the low endpoint feed stock, since higher boiling material would add unduly to the coke production while having minimum effect on the quality or yield of the aviation gasoline produced. When a higher endpoint feed stock is received at Planta K, it is first rerun at 150 C. endpoint before charging to the Hydroformer operation. With this feed stock, the aviation operation is maintained in an approximately 40-hour total cycle time in which the reaction period is 20 hours.

The yield of finished aviation gasoline from the operation is upwards of 50 volume percent on fresh feed. This volumetric yield is a function of the blending of the unstabilized light naphtha and aromatic base stock to meet the volatility specifications of the gasoline. In turn, the ratio between the yields of the light naphtha and the aromatic base stock produced in the operation is influenced by the distillation volatility of the feed stock.

The heavy polymer naphtha produced above the endpoint of the aviation gasoline, from the bottom of the second fractionator tower, has a considerably high aromatic content and is disposed of by sale for solvent production. This heavy naphtha is used also in great part as a motor gasoline component, in which case it is first rerun to endpoint and has an octane number of approximately 88 CFR-Motor method clear.

Basic studies, prior to design of the plant confirmed the use of Kellogg low soda catalyst for the Hydroforming reaction. This catalyst has proved exceedingly effective in the aromatic and aviation gasoline operations and has also shown long life. The plant has been in operation practically continuously for more than a year since April 26, 1951, when it went on stream. During this period one reactor still retains its original catalyst charge; while the other reactor required a catalyst change after eight months due to an operational emergency which caused excessive overheating of the catalyst bed.

Prior to the design of the plant, pilot plant studies on the feed stocks contemplated for use by DGFM, established the operating conditions for the design of the Hydroformer shown in Table 8.

TABLE 8

Design Operating Conditions

Reaction:	
Reactor Average Bed Temperature	980 F.
Reactor Average Bed Pressure	300 psig
Space velocity—V/Hr/V	0.75
Gas Recycle—Basis Reactor Charge	2500 cu. ft./bbl.
Liquid Recycle Ratio—Recycle/Fresh Feed	2
Hydrogen Content in Recycle Gas	69 Mol. Percent
Hydrogen Enrichment	None
Catalyst Regeneration:	
Max. Burning Temperature	1100 F.
Circulating Flue Gas—Temp. Range	650 to 1100 F.
Regeneration Pressure	5 psig

In a fixed bed unit specific operations follow in sequence and are controlled to achieve a definite cycle time, and for the design of this Hydroformer functional times were established as shown in Table 9.

TABLE 9

Reaction	24 hrs.	
Recycle Gas Purge		5 min.
Depressure		10 min.
Flue Gas Purge		5 min.
Coke Burning	18 hrs.	
Catalyst Reheat	2 hrs.	
Catalyst Pretreat	1 hr.	
Repressure		15 min.
Valve Changes		25 min.
Idle	2 hrs.	
Total	48 hrs.	

This design cycle time incorporates sufficient flexibility so that, at will, the total time can be varied to whatever time might be desired.

Planta K is an integrated plant consisting of a Hydroformer with recovery facilities, and a phenol extractive distillation unit which is designed to recover nitration grade toluene produced when charging a narrow-boiling C_7 naphtha fraction to the Hydroformer operation. This plant also produces benzene when charging a narrow boiling C_6 fraction, rich in cyclohexane.

Briefly, the equipment consists of two Hydroformer reactors containing the catalyst wherein the conversion to aromatics is accomplished under specified conditions of operation. Coke is deposited on the catalyst during the reaction period, requiring the catalyst be periodically regenerated. While one reactor is in reaction operation, the spent reactor bed is being regenerated by burning the coke deposition on the catalyst. Associated with these reactors is the regeneration equipment consisting primarily of a flue gas generator which serves as a source of the flue gas used to control the rate and temperature of the burning operation. A predetermined concentration of hydrogen is maintained in the reaction zone by recycling a portion of the hydrogen rich gas produced by the reaction. Products of reaction are recovered into the desired fractions in the Hydroformer fractionation facilities, and the aromatic concentrate is sent to intermediate storage. This crude aromatic concentrate is subsequently contacted countercurrently with phenol in a distillation tower and the aromatic portion of the concentrate is extracted in the phenol phase. Toluene, or benzene, is then removed from the phenol and further purified by acid treating, caustic neutralization and rerunning to produce the finished nitration grade aromatic.

Major Process Steps

In the main, the Hydroforming unit for production of toluene or benzene from a narrow boiling fraction is essentially the same as a Hydroforming unit devoted to the production of motor gasoline from a wide boiling range naphtha stock. The major process steps as incorporated in the design of this Hydroformer may be summarized briefly as:

1) Oxygen removal from the naphtha feed in the gas absorber tower.
2) Heating the naphtha charge and recycle gas to the desired reaction temperature.
3) Reacting the naphtha and recycle gas in the catalyst chamber and cooling the products of reaction.
4) Recirculating the separator gas, rich in hydrogen, as recycle gas to the reaction chamber and feeding net product gas to the absorber tower.
5) Regeneration of the spent catalyst.

Unique design features distinguish this plant from other comparable Hydroformers. Because of the expected high conversion of naphthenes to aromatics and the high heat of reaction involved, a recycle stream of light naphtha containing essentially paraffins and unconverted naphthenes is recirculated from the overhead reflux drum of the phenol recovery tower to the absorber tower accumulator drum where this recycle mixes with the fresh feed to become part of the total reactor charge. This recycle, which is primarily a diluent, is in the ratio of 2 to 1 basis fresh feed, and provides a control over the reaction rate in the reactors. At the same time this recycle provides additional heat input to the reactors without the danger of overheating the fresh feed stock. The hydrogen-rich recycle gas rate of 2500 cubic feet per barrel is based on the total reactor charge including the recycle.

Unlike other Hydroformers this unit is designed for catalyst regeneration at essentially atmospheric pressure primarily because of the low coke production and the lack of economic necessity for steam generation from hot flue gas. Inert gas is generated from light liquid fuel and air at sufficient pressure with controlled rate O_2 concentration and temperature to maintain a maximum allowable regeneration temperature of 1100 F. in the catalyst bed. By means of the newly designed water cooling provision it is possible during regeneration to control the flue gas temperature in the range of 650 to 1100 F. and with O_2 concentrations from 0-20.5 weight percent. The volumetric capacity of air and flue gas can be varied from 50 to 100 percent of design capacity. These operational conditions permit maximum flexibility during the regeneration and reheating periods of the complete Hydroforming cycle.

Since the design feed stock is of an unusually narrow boiling range, and the catalytic reaction for production of aromatics yields a very low percentage of coke, it is possible to design for a 48 hour total reactor cycle time, of which the reaction time constitutes 24 hours. With this extended cycle time the necessity of rigid time control to the minute is unimportant, thus permitting the use of hand operated cycle timers which are extremely adequate, and at the same time, considerably less expensive than the completely automatic cycle controllers.

The phenol extractive distillation portion of Planta K is designed to effect a maximum recovery of nitration grade aromatics from the crude aromatic concentrate produced from the Hydroforming reaction. The main process steps incorporated in the extractive distillation design may be summarized briefly as:

1) Contact of the aromatic concentrate with circulating phenol in the extractive distillation tower in which the desired aromatic is removed in the phenol phase.
2) Recovery of phenol from the hydrocarbon vapor overhead of the extractive distillation tower in a separate phenol recovery tower.
3) Separation of the pure aromatic from the phenol phase in the phenol stripper tower.
4) Acid wash, caustic neutralization and rerunning, followed by drying of the finished nitration grade aromatic.
5) Phenol clean-up to recover the used phenol which ordinarily might be discarded.

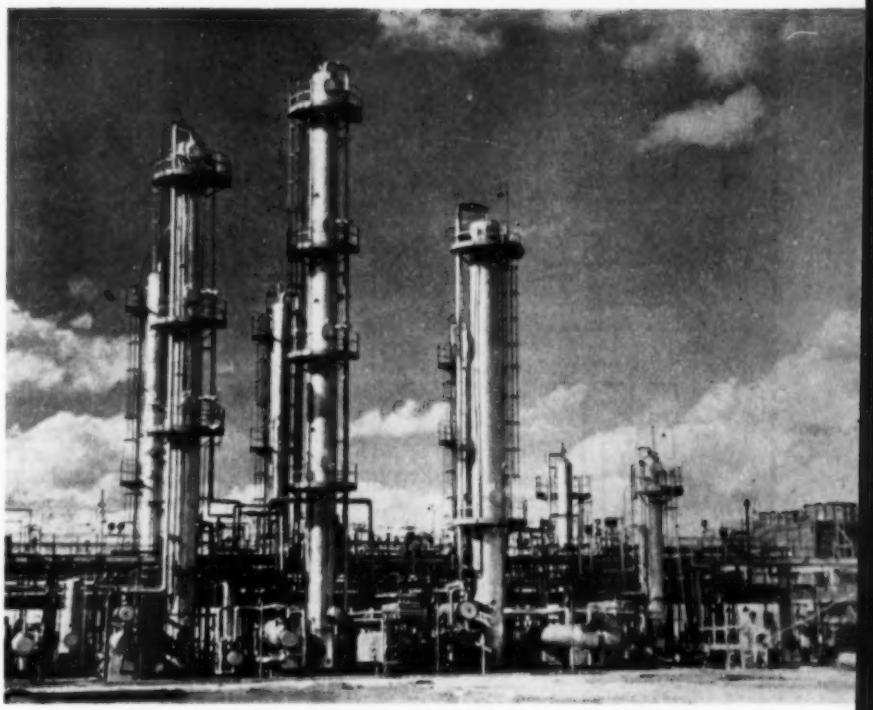


Figure 3. Photo of distillation and aromatic recovery facilities.

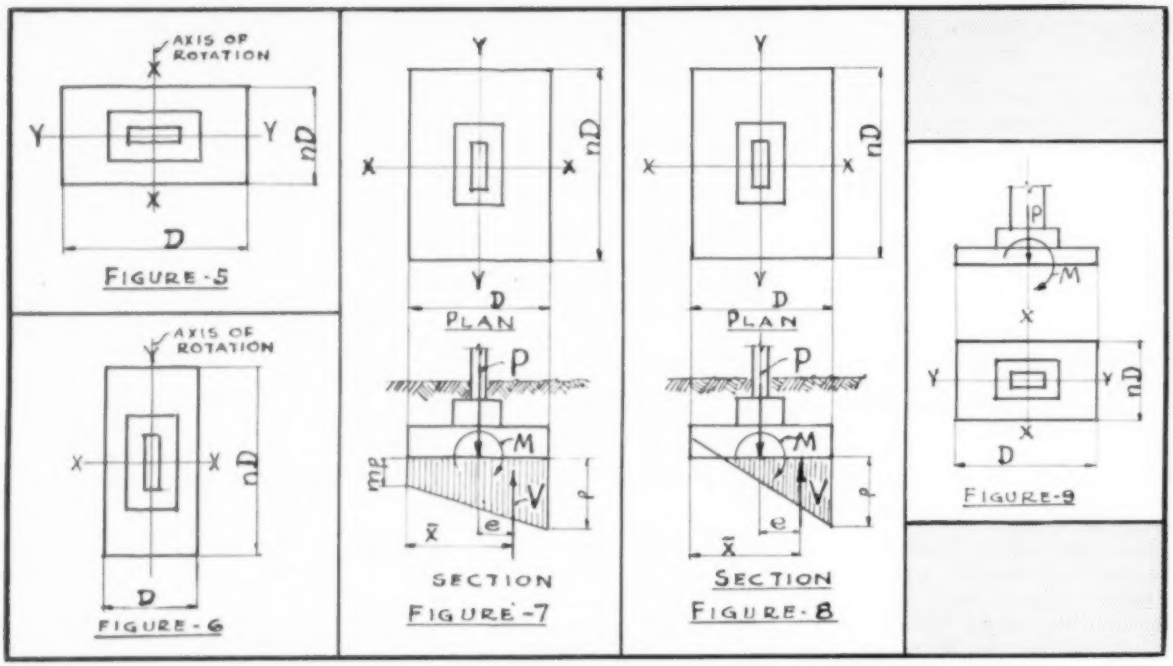
The recovery of the pure aromatic by phenol is dependent upon the temperature and the ratio of circulating phenol to the aromatic concentrate charged to the extractive distillation tower. For design purposes a phenol to concentrate ratio of 6.0 to 1 was used for the toluene extraction. This ratio affords an adequate flexibility in the operation so that maximum recovery can be obtained. In operation the loss of toluene overhead from the extractive distillation tower is minimized, and the use of a separate phenol recovery tower provides a medium for effective fractionation between the unextracted hydrocarbons and the phenol carry-over from the extraction tower. The separated phenol from the bottom of this tower is returned to the extraction tower, thereby minimizing losses of phenol from the operation.

Unique features in this design contribute greatly to the efficiency of the operation. The acid treating of the pure aromatic results in the formation of a very small amount of acid polymer which is subject to thermal decomposition at elevated temperatures. Therefore, in the rerun tower, which is designed to remove any acid polymer formed, some gas oil is injected intermittently with the tower feed to dilute the acid polymer in the tower reboiler system, thereby holding the thermal decomposition of this material to a minimum at the temperature required for the reboiling operation. Any thermal decomposition would show itself in sulfur contamination of the pure aromatic overhead of the rerun tower.

An additional feature is provided in the form of the phenol fractionator to recover contaminated phenol which ordinarily might be removed from the unit. This phenol fractionator is designed with a threefold purpose which includes, a) cleaning out the heavy ends from used phenol by removing phenol alkylates formed during the extraction operation, b) drying of wet phenol, c) drying of phenolic water. The phenol fractionator is so designed that it may be used in intermittent operation apart from the main extraction system, or it may be used continuously, taking its place in the extraction system sequence.

The heat medium for the many reboilers in the fractionation and extraction systems is provided by a closed circulating gas oil system with a separately fired reboiler oil furnace. This reboiler system, with controls at the individual reboilers, is designed to provide effective reboiler control, as desired, independently of the functioning of any other portion of the plant.

* * *



Design of RECTANGULAR FOOTINGS

One set of equations is made to apply to both axis of the footing

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RECTANGULAR footings have many uses in the design of industrial and refinery plants. Their use is required for the support of horizontal vessels, equipment foundations requiring rectangular pads, elongated columns, and in many other places.

In an article of the November, 1952, issue of the PETROLEUM REFINER formulas and graphs were developed for square footings. In the following discussion, the same principles are applied to rectangular footings and in certain cases refer to some of the figures and graphs in the above mentioned article.

It is shown here that Graphs 1 and 2 developed for square footings[1] also can be applied to rectangular footings, when the moment is acting about the principal axis of the footing. The diagonal axis is not considered here. Where the moment acts in any direction around the clock, it is preferable to use a square or octagonal footing because of its greater symmetrical resistance to overturning.

To make one set of equations apply to both axes of a rectangular footing, the following dimension nomenclature is used.

Figures 5 and 6 are plans of the same footing. In Figure 5 the moment is acting about the transverse, or strong Axis x-x, while in Figure 6 the moment is acting about the longitudinal, or weaker Axis y-y. It may be observed from the figures that the *D* dimension is always perpendicular to the axis of rotation, while the *nD* dimension is parallel to the axis of rotation. It may also be noted that in Figure 5, *n* is less than 1.0, and in Figure 6 *n* is greater than 1.0.

All the symbols used in the above mentioned article are also used in the same manner here. The only addition is the symbol *n* described above, consequently all the equations will be similar to those developed for square footings on the rectangular axis.

Static equilibrium is obtained as follows: Refer to Figures 7 and 8.

a) $\Sigma V = O$ The volume of the earth pressure diagram must equal the weight of the structure above, that is. $V - P = O$ or $V = P$.

b) $\Sigma M = O$ The external moment applied to a footing is resisted by the eccentric action of the earth pressure diagram on the footing; that is. $M - Ve = O$, or $M = Ve$.

These principles are used in the following pages to develop the necessary equations for rectangular footings.

Case 1—Trapezoidal Earth Pressure Solid

See Figure 7. Moment acting about longitudinal axis.

The volume and center of gravity of the trapezoid are as follows:

$$\text{Load "P"} = \text{Volume "V"} \quad \text{Also } e = \frac{M}{P}$$

$$V = p\frac{n D^2}{2}(m+1) \qquad (20)$$

Center of gravity of trapezoid from Figure 7 $\bar{x} = \frac{D}{2} + e$ (21)

By taking moments about left side $\bar{x}$ also equals the following:

$$\bar{x} = \frac{D}{3}\left(\frac{m+2}{m+1}\right) \quad (22)$$

To obtain a solution for *e* and *D*. Equate Equations (21) and (22).

$\frac{D}{2} + e = \frac{D}{3} \cdot \frac{m+2}{m+1}$ Then $e = \frac{D}{6} \cdot \frac{1-m}{1+m}$

And $D = 6e\frac{1+m}{1-m}$ (23)

From Equation (20) D may also be obtained

$$D = \sqrt{\frac{2V}{pn(1+m)}} \quad (20a)$$

A relation between the known quantities *P, M, e, p* and the unknown quantity *m* are obtained by equating (20a) and (23).

$$\sqrt{\frac{2V}{pn(1+m)}} = 6e\frac{1+m}{1-m}$$

Then $\frac{V}{18e^2np} = \frac{(1+m)^3}{(1-m)^2}$ (24)

If *a* represents each term

Then $a = \frac{V}{18e^2np}$ Also $a = \frac{(1+m)^3}{(1-m)^2}$

Maximum value of $a = \infty$, minimum value $= 1.0$

In Equation (24) the left term has all known quantities and are obtained by slide rule. This value is then used in Graph 1 (published in article on Square Footings, PETROLEUM REFINER, page 147, November, 1952) to obtain *m*.

The reverse operation; if *D* is known—to find *m* and *p*.

Solving Equation (23) for "m"—

$$m = \frac{D-6e}{D+6e} \quad (23a)$$

Solving Equation (20) for "p"—

$$p = \frac{2V}{nD^2(m+1)} \quad (20a)$$

Note: The same equations may be applied to axis *xx* by reversing the plan dimensions, as previously mentioned.

Case II. Triangular Earth Pressure Solid

Referring to Figure 8, the volume and center of gravity of the triangle of pressure as are follows:

$$V = pnD^2(1-k) \quad (25)$$

Center of gravity of triangular solid from Figure 8, $\bar{x} = \frac{D}{2} + e$ (26)

Taking moments about left side—$\bar{x}$ is also equal to the following:

$$\bar{x} = \frac{D}{3}(k+2) \quad (27)$$

To obtain a solution for *e* and *D* equate (26) and (27)

$$\frac{D}{2} + e = \frac{D}{3}(k+2)$$

SYMBOLS

P	Total load at base of footing.
M	Overturning moment at base of footing.
e	Eccentricity $\frac{M}{P}$
p	Maximum soil pressure
k and m	are fractions.
D	Dimension of footing.
V	Volume of earth pressure solid.
M_1	Moment of earth pressure solid.
$\bar{x}$	Distance to center of gravity of earth pressure solid.
C_1, C_2 and C_3	are coefficients.
K	Kips—1000 lbs.
n	Establishes the ratio between the plan dimensions of the footing.

Then $e = \frac{D}{6}(2k+1)$ (28)

or $D = \frac{6e}{2k+1}$ (29)

From Equation (25) D also equals:

$$D = \sqrt{\frac{2V}{pn(1-k)}} \quad (25a)$$

To obtain a relation between *k* and the known quantities *M, P, e, p:* equate (25a) and (29).

$$\sqrt{\frac{2V}{pn(1-k)}} = \frac{6e}{2k+1}$$

or $\frac{V}{18e^2np} = \frac{1-k}{(2k+1)^3}$ (30)

If *a* is made to represent each term

Then $a = \frac{V}{18e^2np}$ and $a = \frac{1-k}{(2k+1)^3}$

Maximum value of $a = 1.0$; minimum value $= 0$

In Equation (30) the left term has all known quantities and are obtained by slide rule. This value is then used in Graph 2 (published in article on Square Footing, PETROLEUM REFINER, page 147, November, 1952) to obtain *k*.

The reverse operation, if *D* is known—to find *k* and *p*

Solving Equation (29) for *k*—

$$k = \frac{1}{2}\left(\frac{6e}{D} - 1\right) \quad (29a)$$

Solving Equation (25a) for *p*—

$$p = \frac{2V}{nD^2(1-k)} \quad (29b)$$

By reversing the plan dimensions, the same equations apply on axis *xx*.

Examples

A few examples will suffice to illustrate solutions for rectangular footings. Graphs 1 and 2, developed for square footings, are also used for rectangular footings.

Example 5

Determine the short dimension of a rectangular footing, if the ratio *n* is established equal to 1.67 and $p = 3500$ pounds per square foot.

Total load $P = 80{,}000$ pounds.

Moment $M = 100{,}000$ foot pounds. Moment acts on either axis, but not simultaneously.

a) Moment acting about longitudinal axis Y-Y

$$e = \frac{M}{P} = \frac{100{,}000}{80{,}000} = 1.25 \text{ feet.}$$

$$a = \frac{V}{18e^2np} = \frac{80{,}000}{18 \cdot 1.25^2 \cdot 1.67 \cdot 3500} =$$

$.487 < 1.0$ Case II problem

From Graph 2.

When $a = .487$ $k = .155$

$$D = \sqrt{\frac{2V}{pn(1-k)}} \quad (25a)$$

$$D = \sqrt{\frac{2 \cdot 80{,}000}{3500 \cdot 1.67(1-.155)}} =$$

5.68 feet transverse dimension.

Longitudinal dimension $nD = 1.67 \cdot 5.68 = 9.5$ feet.

b) With the dimensions established, check soil pressure *p* when moment acts about x-x axis:

Here $D = 9.5$ feet, $n = \frac{1}{1.67} = .6$, $e =$ 1.25 feet.

$$k = \frac{1}{2}\left(\frac{6e}{D} - 1\right) \quad (29a)$$

$$k = \frac{1}{2}\left(\frac{6 \cdot 1.25}{9.5} - 1\right) = .105$$

$$p = \frac{2V}{nD^2(1-k)}$$

$$p = \frac{2 \cdot 80{,}000}{.6 \cdot 9.5^2(1-.105)} =$$

3300 pounds per square foot.

Example 6

Given.. { Load P = 200.0 K. Moment Mx = 350.0 F.K. Moment My = 220.0 F.K.

$p = 4000$ pounds per square foot.

If the sides of the rectangle are made proportional to the moments; then $n = .628$ or 1.59 depending which axis is considered.

a) Consider moment acting about the x-x axis, Figure 9.

1st combination $\begin{matrix} P = 200.0 \text{ K.} \\ Mx = 350.0 \text{ F.K.} \end{matrix}$ $n = .628$

$$e = \frac{M}{P} = \frac{350.0}{200.0} = 1.75 \text{ feet.}$$

$$a = \frac{V}{18e^2np} = \frac{200{,}000}{18 \cdot 1.75^2 \cdot .628 \cdot 4000} =$$

1.44 Case I

From Graph 1, when $a = 1.44$, $m = .07$

$$D = \sqrt{\frac{2V}{pn(1+m)}} \quad (20a) =$$

$$\sqrt{\frac{2 \cdot 200{,}000}{4000 \cdot .628 \cdot (1.07)}} = 12.2 \text{ feet.}$$

Then $nD = .628 \cdot 12.2 = 7.66$

b) If the moment about the Y-Y axis had been considered, the same size would be obtained. This size-ratio gives a well balanced design.

LITERATURE CITED

[1] "The use of Graphical Methods in the design of Square Footings" PETROLEUM REFINER, November Issue 31, No. 11, p. 145 (1952).

Mobile crane utilized for hoisting materials into unit structure.

Material transportation by means of straddle carriers and pallets.

Techniques for Cat Unit Turnarounds

Presenting the complete details on how to conduct a turnaround. Manpower coordination is clearly described

J. G. Traxler and K. T. Beavers
Humble Oil & Refining Company
Baytown

SIGNIFICANT AMOUNTS of money can be trimmed from the cost of cat unit turnarounds with careful planning. The practices now in use for repairing these units have been developed through many years of experience. An economical turnaround is obtained through the frugal and judicious use of manpower and materials. Here are the details on turnarounds for Fluid catalyst cracking units at Humble Oil & Refining Company's Baytown, Texas, refinery.

Turnaround planning begins with a meeting of all departments concerned for the consideration of the work to be done during the turnaround. By the time of this meeting tentative work lists have been drawn up by the Inspection, Process, and Technical Service divisions. Proposals for additional work are heard at this meeting and plans are made accordingly.

Knowing the extent of the turnaround by this time, the turnaround supervisor is in a position to begin specific planning. Engineering drawings not already in the field are expedited, materials are expedited, final work lists are drawn up and a roster of supervisors is prepared. Manpower requirements from each craft are estimated for each job on the work list and over-all requirements for each craft are prepared by shift, day, and week. Pre-turnaround fabrication of pipe, etc., is started wherever possible. Everything that can be accomplished ahead of the shutdown is done, such as prefabrication, erection of scaffolds, removal of insulation and locating of tools, equipment, and materials on the job site. Turnarounds are worked on a two-shift-per-day basis. Virtually no work is done on the graveyard (12 m. to 8 a.m.) shift; any real major bottlenecks, however, are covered on this shift. Marginal manpower available for the regular plant 12 to 8 shift is used if suitable jobs exist. The turnaround downtime and manpower required varies from time to time depending on the magnitude and nature of the nonroutine work that is to be performed.

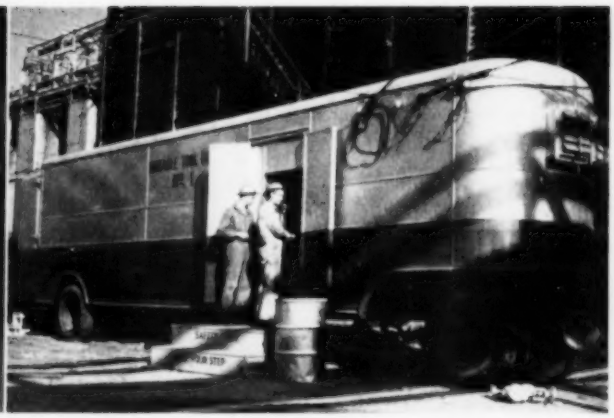
The control and coordination of manpower, material and equipment are essential elements in performing turnaround work efficiently. To accomplish this, adequate and capable supervision must be provided in the right places at all times.

The general supervision of turnaround crews has been improved by assigning a section of the unit to the over-all supervision of one individual. For example, a unit is now divided into three sections: 1) ground, mezzanine and fractionation section, 2) floors Nos. 2-13, and 3) floors Nos. 14 and above. One over-all supervisor is responsible for the work that goes on within each of these designated sections.

Supervision for each of the crafts on the turnarounds also has been increased in recent years. For a typical turnaround there are 13 full-time craft supervisors on the day shift and 10

MAINTENANCE / OPERATION

Prefabrication of vessel internals in central shops prior to turnaround.



Mobile tool room which is used extensively in turnaround projects.

on the 4-12 shift. Three crafts—boilermakers, pipefitters, and welders—normally have a supervisor plus an assistant supervisor on each of the two shifts. Craft supervisors are selected jointly by the turnaround supervisor and the craft general foreman.

The assistant turnaround supervisor is responsible for making all manpower arrangements with the Central Planning and Coordination Group and also is contact man for all turnaround work done in the shops. The supervisory roster for a typical turnaround is shown in Table 1.

Turnaround supervisors are gathered for an orientation session before the turnaround. Many on-the-job conferences are held. These discussions comprise a study of work to be done, with particular emphasis on changes and additions to the unit. Drawings are studied, coordinated plans are made, and much time is spent on the unit in going over the plans. This procedure familiarizes the supervisors with each other, with the over-all and detailed plans, and with the attendant conditions on the unit. Ideas are pooled and short cuts devised. A spirit of team work is developed.

Supporting Staff Functions

For each turnaround the Engineering division provides a representative to follow work in the field. It is not always possible to have all drawings in the field by the time the turnaround is begun. This representative is able to assist the turnaround supervisor by supplying needed information on the spot or by checking with his division. With this arrangement work can proceed without delay and without conflict.

It is general practice to divide the metal inspectors group into two teams with one team assigned to the day shift and the other to the 4-12 shift for the duration of the turnaround. In general, four inspectors comprise each team. With as many as four metal inspectors per shift, inspections are made expeditiously and in various parts of the unit simultaneously. There is no delay on the night shift. Craftsmen's efficiency is increased as a result of on the spot decisions by the inspectors. This arrangement is consistent with other efforts to shorten turnarounds.

Gas testers (who provide the gas analysis certificate prior to issuance of hot work permits and permits to enter closed vessels) are made available at the unit at all times.

TABLE 1. Supervisory Roster

Day Shift

Over-all Supervision
- Turnaround Supervisor
- Assistant Turnaround Supervisor
- Ground, Mezzanine, and Fractionation Supervisor
- Floors 2-13, Inclusive, Supervisor
- Floors 14 and Up, Inclusive, Supervisor

Craft Supervision
- Brickmason
- Boilermaker
- Boilermaker Assistant
- Carpenter
- Electric
- Insulation
- Instrument
- Labor
- Machinist
- Paint*
- Pipe
- Pipe Assistant
- Rigging
- Sheet Metal*
- Tube Cleaners*
- Welding
- Welding Assistant
- Storehouse

4-12 Shift

Over-all Supervision
- Turnaround Supervisor
- Ground, Mezzanine, and Fractionation Supervisor
- Floors 2-13, Inclusive, Supervisor
- Floors 14 and Up, Inclusive, Supervisor

Craft Supervision
- Boilermaker
- Boilermaker Assistant
- Carpenter
- Labor
- Pipe
- Pipe Assistant
- Rigging
- Tube Cleaners
- Welding
- Welding Assistant

*Indicates part time supervision as required from day-to-day.

Tools and Methods

Items of material issued in quantity are now stored and issued right at the unit from 4-foot square boxes made on standard pallets for transporting by straddle trucks. Four of these material boxes are used. During a turnaround as much as 40 percent of the material used is issued from these material boxes at the unit. In general, the special material comes largely from the storehouse, and most of the common materials come from the turnaround stock at the unit.

A mobile tool room has been in use since September, 1947. This tool room is a full van-type trailer 38 feet long and 8 feet wide with a side access door and double doors at the rear. The tool stock is checked and replenished and the tool room is moved to the unit usually prior to actual shutdown. An average of about 400 tools or related items are issued per day. The items carried are, in general, of the following type: air tools, hand tools, electric powered tools, hoses, light chain blocks, goggles, stationery supplies, and coveralls. The tool room also houses the loudspeaker amplifier and microphone, and is hooked up to the telephone system in the unit structure. It serves as tool room and communication center for the turnaround.

An operator is assigned full time to

the elevators during the time the turnaround is in progress. It is standard practice to stop the elevator only at designated floors for taking on or letting off passengers. Material or equipment will be let off or picked up at any desired floor.

Hoisting facilities have been installed on the units as a means of handling bulky and heavy items or items in quantity such as multiclones, tile, trash, etc. The No. 1 catalyst unit has three derricks on the structure:

1. A 1000-pound derrick is located on the 18th floor.
2. A 7000-pound guy derrick is located on the 18th floor.
3. A 12,000-pound capacity stiffleg derrick is located on the top floor.

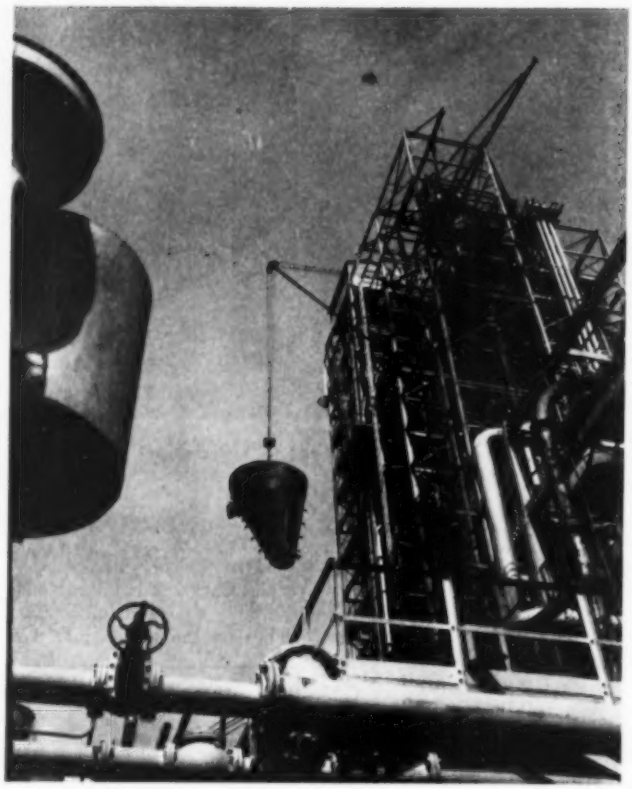
The No. 2 catalyst unit has three lifting rigs in the structure:

1. A 1000-pound davit is located on the top floor.
2. Another identical 1000-pound rig is located on the 9th floor.
3. A 10,000-pound davit type derrick is located on the 13th floor at the regenerator.

Increasing use is being made of mobile equipment on turnarounds. Large and small pneumatic-tired cranes are being used very effectively in and around the units in dismantling and erecting piping, handling exchanger bundles, pumps, motors, furnace tubes, etc. A 40-ton crawler crane with 100-foot boom and 20-foot jib is usually used at each major cat unit turnaround. When plans are not made initially to use such a crane, it has enough mobility to be brought into the unit area in approximately two hours after the decision is made to utilize it. Mobile cranes equipped with two-way radios can be brought to the unit in a matter of a few minutes. Three and five-ton mobile cranes are stationed at the unit at all times.

Electrical outlets for welding machines have been installed at various locations in the structures from time to time since construction of the units. Through experience it is felt that an optimum number has been installed in each unit. Welding requirements vary from turnaround to turnaround and any shortages in welding outlets are taken care of by temporary installations.

Piping has been installed in each unit for the distribution of oxygen used in cutting operations. A 1½-inch header extends from the ground to the top of each unit. At Fluid cat cracker unit No. 1 there are two ¾-inch outlets per floor and at Fluid cat cracker unit No. 2 there are two outlets on every other floor. Oxygen is purchased in 11,000-cubic foot lots in trailers which are parked at the unit and tied into the distribution system. This eliminates the handling of many drums holding 244 cubic feet each. A savings in excess of 30 cents per 100 cubic feet is realized by using bulk oxygen instead of bottled oxygen. An additional savings is realized from the reduced handling of oxygen bottles. During a recent turnaround, a total of 49,370 cubic feet of oxygen was used in five trailer loads. This is equivalent to 202 bottles which would have had to be moved up and down the structure.



Utilizing "built-in" hoisting equipment for installing prefabricated section.

Manways have been installed in the units wherever justification existed as a means 1) toward safer working conditions, 2) to allow simultaneous work in adjacent parts of the unit, 3) to eliminate necessity of removing equipment such as slide valves or long pieces of large pipe in order to enter a part of a unit, and 4) to eliminate building extensive scaffolds such as would be needed to get to the cyclones in a Model II regenerator.

Increasing use has been made of chemical cleaning services offered by commercial firms in the area. The water side of some shell and tube type heat exchangers and some cooling water systems of pumps and engines are cleaned by this method at every cat unit turnaround. A low unit cleaning cost is realized by including a large number of exchangers and pumps. Recent experience indicated savings of $50 to $65 per exchanger for chemical cleaning over sandblasting. There is an additional advantage of releasing critical manpower to other work.

Small Changes and Betterments Versus Additional Downtime

Refinery management critically reviews proposed jobs to be authorized after the turnaround basis has been established and evaluates payout versus added downtime of the unit.

A list of jobs was drawn up after a recent emergency shutdown, in which the items of repair and proposed changes were placed in three categories: 1) top priority, 2) those which should be done if possible without extending the turnaround, and 3) marginal jobs in case time and manpower were available. An order of preference was further indicated within each category. Careful review was made of availability of materials, craftsmen, and shop potential. Except for the top priority group only those items which could be completed without extending the turnaround were done. This scheme has the further advantage of assessing full and complete economic analysis to jobs which otherwise might creep into being without adequate justification.

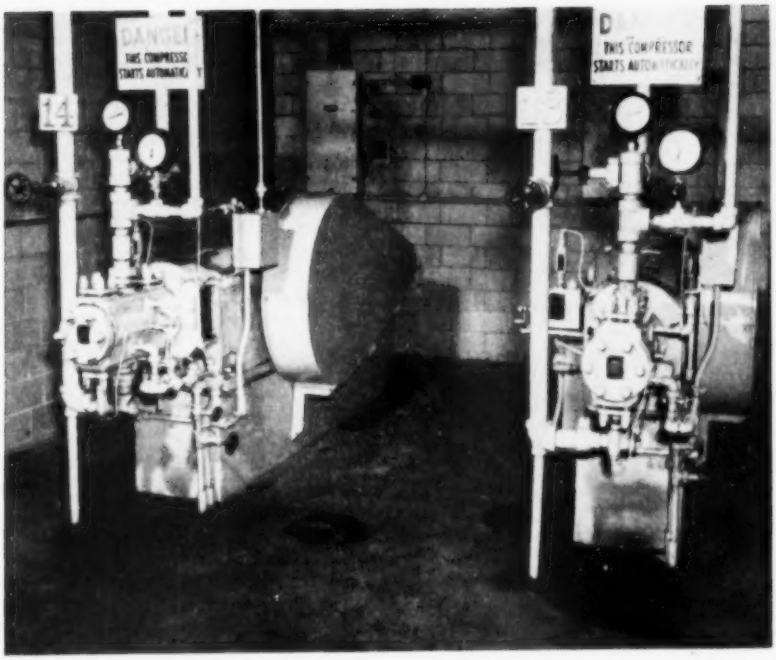


Figure 1. Automatically controlled compressors with instruments and controls easily accessible. Note lubricator, belt guards and neat piping.

How to Select Compressors

Data and information are given which provide a basis for choosing the proper type and size compressor for your requirements.

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RECIPROCATING air compressors for refineries and petrochemical plants may be divided into three general classes: 1) light, intermittent duty, 2) heavy industrial, medium duty, and 3) large, heavy-duty units. This is a broad classification that overlooks a few of the finer subdivisions used by some manufacturers. However it is quite adequate for usual plant design and operating problems. Where a more accurate subdivision is necessary it will be indicated later in this article.

Using these three classes of compressors as our base we can arrive at the most economical and suitable units for our refinery. Since many air compressors in the petroleum industry run around the clock, a suitable starting point in compressor selection is extremely important. The right compressor, properly installed, can sometimes save its first cost during half its normal life. Some refineries have paid off their compressors in shorter periods when savings were high.

Light, Intermittent Duty

Where a compressor doesn't run more than about one hour per day, small single-stage air-cooled units with discharge pressures up to 150 psi are usually satisfactory. Motor drive, if used, consists of a direct- or belt-connected induction motor that turns compressor at a speed of 700 to 1500 rpm. If electric power is unavailable either a small gasoline or diesel engine can be used. Power input to the compressor seldom exceeds three horsepower.

Air-cooled, these units may be run outdoors or in unheated buildings. Important design features in units of this type are low cost and light weight. Major uses include air supply for refining operations requiring small quantities of compressed air, standby service in refineries where large units handle main load, construction jobs that do not require enough air for use of larger portable compressors, and for supplying air at remote locations —such as refinery loading docks and tank farms.

Heavy Industrial, Medium Duty

Compressors running four to eight hours per day usually fall into the heavy industrial, medium-duty class. Classification may vary somewhat but when power input ranges between 10 and 15 horsepower, pressures to about 80 psi, single-stage air-cooled compressors usually prove out. With higher pressures or longer operating periods, air-cooled two-stage compressors may prove more economical. While these units may not always be classified "heavy industrial" by their builders, they do serve loads of a nature well defined by this term. Actual construction of these compressors may include such desirable features as light weight, portability, simple installation, easy control and freedom from vibration. Either the unit or central distribution system is suitable, with the former growing in popularity.

For power inputs of 10 to 100 horsepower the horizontal single-cylinder, single-stage, double-acting water-cooled compressor gives fine service in the 100-psi range. Many units of this design run around the clock for years without excessive maintenance. And, of course, they are suitable for jobs requiring less running time. Units of this type are popular in refineries and petrochemical plants for instrument-air and similar services.

Drives for compressors in the 10 to 100-horsepower range often consist of V-belts or short-center endless belting with a gravity idler. Motor is mounted on a pivot base on the compressor or on a sliding base on the compressor foundation.

A more recent addition to this field of service for one-shift (8 to 10 hours per day) use is the two-stage air-cooled compressor. These are usually

TABLE 1

Calculated Cost of Compressed Air 100-lb. Pressure

UNIT	A			B			C		
Motor Size	40			125			500		
Actual Capacity C.F.M.—Full Load	156			659			2,700		
Operating Hours/Month	220			220			220		
INITIAL INVESTMENT									
Equipment Cost	$2,152			$8,932			$25,252		
Installation Cost	244			1,118			5,675		
Total Installed Cost	$2,396			$10,050			$30,927		
MONTHLY CHARGES									
Fixed Charges and Repairs	$23.00			$50.25			$154.64		
Lubrication	1.15			1.07			4.29		
Attendance	27.50			55.00			55.00		
Cooling Water	.....			30.50			106.80		
Total Charges, Less Power	$51.65			$136.82			$320.73		
POWER CALCULATIONS									
Load Factor	100%	75%	50%	100%	75%	50%	100%	75%	50%
Total Air in Thousands Cu. Ft./Month	2,060	1,545	1,030	8,700	6,525	4,350	35,640	26,730	17,820
Kw Hours/Month	6,380	5,236	4,092	21,868	17,116	12,386	85,690	66,792	48,356
Ratio: Compressor kw Hrs. to Total Plant kw Hrs.	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Total Plant kw Hours	51,040	41,888	32,736	174,944	136,928	99,088	685,520	534,336	386,848
Kw Maximum Demand—Compressor Only	29	29	29	99	99	78	390	390	303
TOTAL PLANT ELECTRICAL ENERGY COST									
1st 1,000 kw Hours @ $0.03	$30	$30	$30	$30	$30	$30	$30	$30	$30
Next 4,000 kw Hours @ $0.02	80	80	80	80	80	80	80	80	80
Next 15,000 kw Hours @ $0.01	150	150	150	150	150	150	150	150	150
Next 30,000 kw Hours @ $0.009	270	198	116	270	270	270	270	270	270
Next 50,000 kw Hours @ $0.008	8	.....	.....	400	400	394	400	400	400
Next 100,000 kw Hours @ $0.007	.....	.....	.....	526	260	.....	700	700	700
Next 100,000 kw Hours @ $0.006	.....	.....	.....	.....	.....	.....	600	600	600
Over 300,000 kw Hours @ $0.005	.....	.....	.....	.....	.....	.....	1,929	1,172	434
Total Plant Energy Cost	$538	$458	$376	$1,456	$1,190	$924	$4,159	$3,402	$2,664
COMPRESSED AIR COSTS									
Energy @ 1/8 Plant Total	$67	$57	$47	$182	$149	$116	$520	$425	$333
Compressor Demand—Charge	29	29	29	99	99	78	390	390	303
Fixed Charges	52	52	52	137	137	137	321	321	321
Total Air Cost/Month	148	138	128	418	385	331	1,231	1,136	957
Cost of Air/1,000 Cu. Ft.	$0.0718	$0.0893	$0.1241	$0.048	$0.59	$0.076	$0.0345	$0.0425	$0.0576

low-cost, light-weight, simple-to-install units.

Large, Heavy-Duty Compressors

For refinery repair and maintenance shop service these are usually two-stage, water-cooled, double-acting with capacities ranging upward from about 400 cfm. Having greater first cost, these units show high efficiency with low maintenance costs. They are generally the backbone of large central systems. Speeds range from less than 200 to more than 600 rpm, depending on design. In recent years, flange-mounted induction or synchronous motors have been introduced to reduce space required for the compressor but maintain the inherent high efficiency of the large unit. First cost is also reduced, making these units more nearly competitive with Class 2, above.

Compressor Cooling

To select an air compressor intelligently you must understand the effects of cooling on power consumption. This is best illustrated by examples showing how power input varies in cooled and uncooled units.

Heat is generated when air is compressed from atmospheric pressure to a higher pressure. This heat increases the air temperature, and as temperature rises so does the volume of the compressed air. So we find that a single-stage uncooled compressor takes about one-third more power when discharging at 100 psi than a unit fitted with a suitable cooling system. Since power to drive compressors may account for 75 to 85 percent of the operating cost, the use of a good cooling system is readily apparent.

In general, water-cooled compressor jackets, inter- and after-coolers reduce power costs more than air-cooled parts. However, the initial cost of an air-cooled compressor is lower because cooling-water piping is not needed. Also, there is no need to include water cost as part of compressor operating cost.

Large air-cooled compressors usually have top limits of 125-psi discharge pressure and 100-horsepower input. Small-size units, 5 to 10 horsepower, have discharge pressures considerably higher than 125 psi. Water-cooled compressors are generally available from 5 horsepower up. Large compressors are always water-cooled.

In the range where water-cooled and air-cooled compressors are both available, the best type for the job depends on a number of conditions—water cost, daily operating periods, power cost and cooling-water quality. Air-cooled compressors are especially good for refineries where there is danger of freezing, where attendance or automatic control cost is high, and where the compressor must run in isolated locations. Water-cooled units are a must where compressor heat is objectionable and where inlet air temperature is high.

Compressor Staging

Cooling is not the only process that reduces power needed for compressing air. Use of more than one step to compress air, with intercooling between steps, also reduces power input. Single-stage compressors raise air pressure from intake to discharge in one step

while two-stage units use two steps. Multistage compressors are units with two or more stages.

While there are no hard and fast rules for choosing the number of stages, the Compressed Air and Gas Institute recommends that compressor size, ratio of compression, discharge-temperature limitations, power cost, continuity of service, cooling method, and nature of installation be considered. The Institute also suggests a rough dividing line, as follows: for pressures below 60 psi, use single-stage compression; for pressures above 100 psi, two-stage; between 60 and 100 psi use single-stage units for capacities below 300 cfm, and two-stage for larger sizes. This rule is applicable to usual refineries and petrochemical plants.

Compressor Efficiency

To the refinery designer or operator who selects air compressors at irregular intervals the various efficiency terms used are likely to be confusing. This is especially so when considering mechanical efficiency and compression efficiency. Getting down to the basic facts of practical compressor selection, the only real standards are actual capacity of compressor and power needed per unit of air actually delivered.

A statement of these standards could be made in any one of the following ways: actual air delivery of, say 100 cfm per kilowatt hour for electric-motor drive, per gallon of gasoline or diesel oil for gasoline- or diesel-engine drive, or per pound of steam for steam-engine drive.

When comparing compressors with different types of drives, reduce all input energy quantities to a common factor by assigning suitable cost values to each. Other cost factors that must be considered include: labor, lubrication, depreciation, maintenance and interest on the investment.

Compressor Selection

Refinery air requirements (2900 cfm) and class of service expected (around the clock with fairly heavy demands at most times) indicates that our compressor or compressors must be at least Class 2 units, heavy industrial, medium duty. Actually, Class 3 units, large, heavy-duty, are more suitable. Where unit-system air distribution is preferable, Class 2 compressors could be used. Since maximum air pressure needed by the majority of tools is 100 psi or less (Table 2, Part I of this article) either air- or water-cooled compressors of suitable capacity are usable. Choose compressor capacity so there is sufficient air for the area the unit serves and enough capacity to allow for increased needs. When choosing between air- and water-cooled units, consider initial, operating and maintenance costs. The design that delivers the needed air at the right pressure with lowest over-all costs is usually the best. However, where unusual needs enter the picture these must be considered too. Table 1 shows a typical calculation for compressed-air costs. Dollar values in this table are not to be taken as typical of today's prices for equipment and services in any particular section of the country. They simply illustrate the procedure to be followed to compute air costs when accurate, up-to-the-minute costs are available.

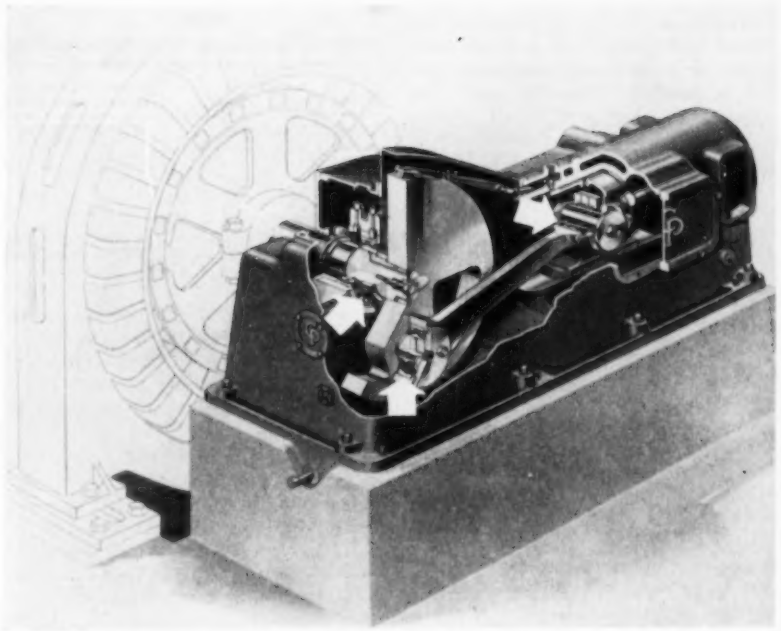


Figure 2. Large heavy-duty compressor has roller bearings at wrist and crank pins and at main shaft.

If the central distribution system is preferred for this refinery, two Class 3 compressors, each rated at about 1500 cfm would probably be suitable. It is wise to use at least two compressors for central systems because then there is little danger of complete loss of air supply during shutdowns for periodic maintenance. Where only a small amount of air will be needed during shutdown of the large unit, a small standby Class I compressor is suitable. But if large quantities of air are needed at all times, as in this refinery, two or more large compressors, as first suggested, are better. Then you will be sure to have enough capacity to run essential tools and process units during shutdown of one compressor for routine maintenance.

Where only a few operations need air at a pressure higher than in the rest of the refinery, it usually will be more economical to install a small separate compressor to serve these loads. The machine can be located close to the high-pressure loads so that pressure loss in piping is low. Use reducing valves to supply moderate quantities of air to loads needing a pressure lower than that in the rest of the refinery. Where large quantities of low-pressure air are required, install a separate compressor for this service.

If you make an economic study of reciprocating and rotary compressors you will find that very large quantities of air at about 30 psi or lower can be more economically supplied by turbo-blowers or rotary-type compressors.

Portable Compressors

Standard portables are rated to discharge at 100 psi when running at sea level. However, there is some variation in different designs and it is best to consult the manufacturer when you contemplate running the unit at other than sea-level locations. Design modifications can be made where operating conditions are unusual. Table 2 lists model classifications and capacities of standard portable compressors.

Compressor Capacity Control

There are extremely few refinery and petrochemical plants in which air demand is constant. Instead, demand

fluctuates as tools and processes are started and stopped. As a result some means of controlling compressor output is needed. Properly controlled compressors discharge small quantities of air when demand is light, large quantities when it is heavy. Air is not wasted and system operating costs are lower.

Just as there are a number of compressor designs, so too are there a number of different control types. Each has its special applications and part of the job of engineering refinery and petrochemical air-compressor installations is choosing controls that will give best service.

Many capacity controls (also called unloading devices) are actuated by pressure in the system supplying the loads. When more air than compressor discharges is used, system pressure falls. Pressure rises when less air than compressor discharges is used. To take care of either condition we can do a number of things. The first is variation of compressor speed.

Running a reciprocating air compressor faster increases the amount of air it delivers to system. Reducing speed cuts its air output. So a pressure regulator that actuates a control to vary prime mover speed in relation to air demand makes a good capacity control. Variable-speed control is used most often with steam-, gas- and diesel-engine driven compressors. It may also be used with some centrifugal compressors and blowers.

However, since most modern compressors are motor-driven, variable-speed control is not too widely used. Motors cost less and run better at constant speed. So we find that constant-speed and start-and-stop controls are widely used on reciprocating compressors up to about 100 horsepower. Beyond this power rating other considerations enter and different controls may be used.

With constant-speed control the compressor runs continuously at rated speed during the plant operating day. When system needs air the compressor discharges it at design pressure. If air demand falls off, compressor is unloaded by holding the suction valve closed (closed-suction unloader) or allowing the inlet valves to remain open (open-inlet-valve unloader). With either control the compressor does not discharge air to the system. Closing the suction valve prevents air entering the cylinder so there is no discharge. Opening the inlet valves and keeping them open permits air to be drawn into the cylinder on the suction stroke and discharged back to the atmosphere on the return stroke. System receives no air from the compressor. These controls are good where air demand is fairly constant.

TABLE 2
Portable Compressor Model Classifications

MODEL NO.	Capacity, cfm Free Air at 100 psi, at Sea Level
60	60
105	61–105
160	106–160
210	161–210
315	211–315
420	316–420
500	421–500

No special designations are set up for sizes larger than No. 500.

Start-and-stop controls automatically start the compressor when air demand rises, stop it when demand ceases. System pressure is allowed to fall about 20 percent between the time the compressor stops and starts. This control is best where there are long periods of no demand for air from the compressor.

Where desired, dual control combining constant-speed and start-and-stop may be used. Manual switch permits selection of either control desired. During heavy daytime air demand compressor runs at constant speed. At night when load is intermittent, compressor runs start-and-stop.

Compressors rated at more than 100 horsepower use step control. Motor runs at constant speed and the compressor is unloaded in three or five steps. With three-step control the compressor runs at full, half or no load, depending on system air demand. Five-step controls run the compressor at full, three-fourths, one-half, one-fourth, and no load, depending on demand. Free-air unloaders are often used for three-step control, clearance pockets for five-step. Breaking point between three- and five-step control is usually at 150 horsepower, five-step being used for most compressors above 150 horsepower.

Compressor Drives

Electric motors, steam engines, and diesel and gas engines may be used to drive air compressors. By far the most popular drive for refinery air compressors today is the electric motor. However, where steam is available at low cost or where gas, diesel oil or gasoline prices are low enough to be competitive with electricity, any one of these drives may be chosen. Much depends on refinery heat balance and local fuel conditions, present and future.

Electric Motors

Up to 30 horsepower, motors for Class 1 and 2 compressors are often squirrel-cage induction units using low starting current. They are fitted with full-voltage magnetic starters. Above 30 horsepower a normal-starting current, normal-torque motor fitted with manual reduced-voltage or magnetic starter is often used. Where compressor runs at full load for long periods or where atmospheric temperature is high, drive motor needs special study to see if it can carry load without overheating. In some refineries and petrochemical plants in warm climates an oversize motor may be needed to prevent failure in service.

For large compressors, Class 3 below 75 horsepower, squirrel-cage induction motors with reduced-voltage starters are suitable because compressors of this size are unloaded during starting. Synchronous motors are generally used when power input is greater than 75 horsepower. They are especially good where power-factor correction and saving of space are important. Present practice connects the motor directly to compressor shaft, avoiding belt losses and maintenance. For minimum space requirements the rotor is mounted on compressor shaft. Starter is usually magnetic full-voltage type.

Best practice in plant design is to use the motor recommended by compressor manufacturer. Such factors as starting torque, starting current, flywheel effect and others, are then taken care of by the compressor builder.

Steam Engines

Most manufacturers of large reciprocating air compressors build and sell steam-driven units. Though the steam-driven compressor may seem old-fashioned in these days of steam and gas turbines in refining and petrochemical plants, it still has many uses. Though selection is always an engineering problem to be decided on the basis of economics and other factors, steam-driven units should be considered when either high- or low-pressure steam is available in the refinery.

Steam-driven double-acting compressors have the engine built as an integral part of the compressor. Simple cylinders are available for low-pressure steam, or high back pressures. Compound engines are used for high-pressure steam.

Internal-Combustion Engines

Portable compressors use direct-connected gasoline or diesel engines. Operation is automatic once the engine is started. The air receiver is usually mounted directly on the compressor frame.

MAINTENANCE / OPERATION

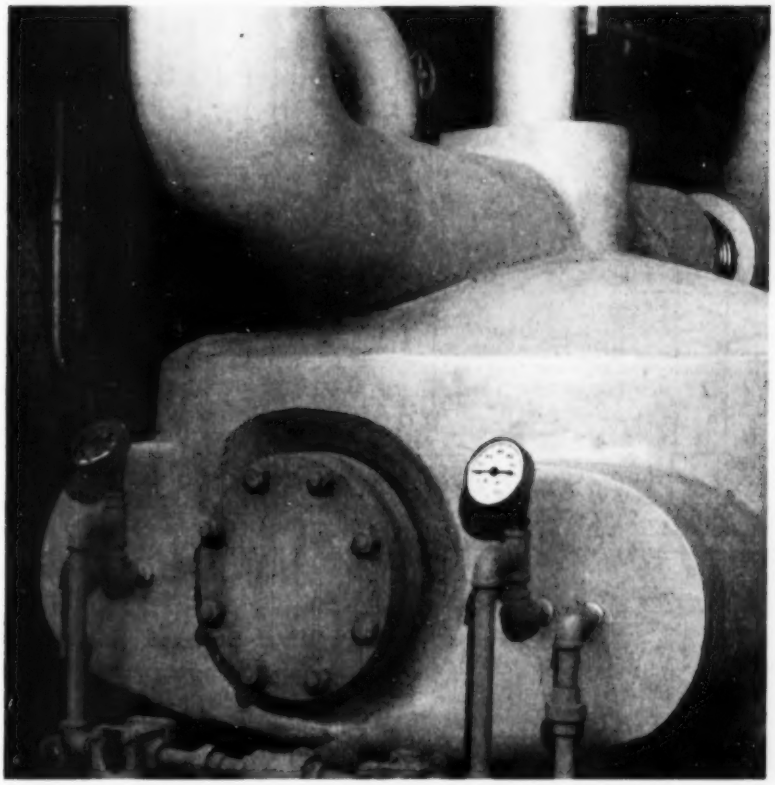
[How to Do It]

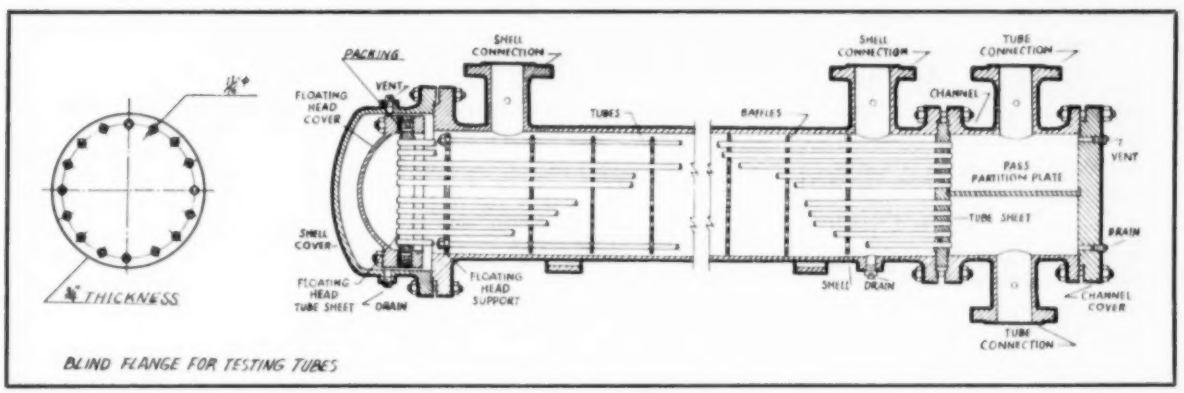
Neat Insulating Cuts Those Operation Costs

Insulation maintenance is a neglected factor in many plants and often leads to costly heat losses or operating inefficiencies. The need for maintenance may result from normal wear and tear, from failure to repair or replace insulation damaged or removed during alternations, or from routine equipment maintenance work.

Most frequently, the need for insulation repair on pipe lines can be noticed around flanges and fittings which are opened for inspection or other purposes. Pipe insulation adjacent to chain hoists, doors or other moving objects may be damaged if not properly protected. Loose tie wires or bands and damaged canvas covering should be checked and repaired. Small fittings insulated with cement are more likely to need periodic reinsulation than pipes and larger fittings having molded insulation.

The accompanying photo shows a model insulation job. Edges subject to hard contacts with moving equipment have been rounded. Note the beveled insert around the blind flange. This permits easy access without expensive destruction of insulation.





BLIND FLANGE FOR TESTING TUBES

Isolating Faulty Tubes Uncovers Exchanger Leaks

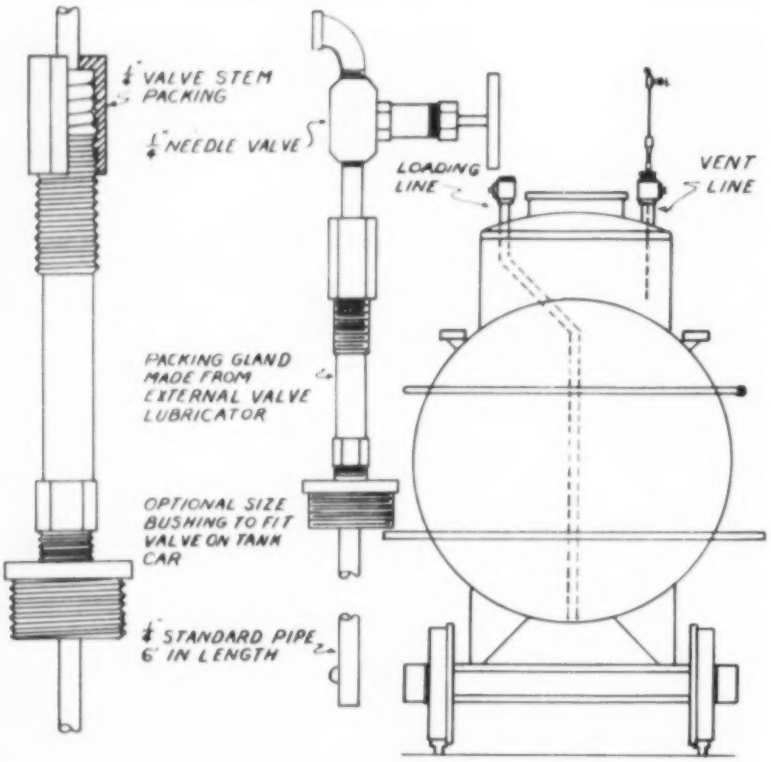
All the way from a refinery in Formosa has come this suggestion for a rapid method for determining which tubes in an exchanger bundle are leaking without removing the tube bundle from the shell. The method is superior to the conventional system of using wooden plugs because it is considerably faster and isolates all faulty tubes at the same time. The accompanying drawing shows the integral parts of a typical exchanger. Use it to follow these directions.

First prepare two ⅛-inch thick rubber sheets with bolt holes on the same pattern as the floating head cover. Next prepare a blind flange punched with bolt holes on the same pattern. This equipment is used to blank off all the tubes on the floating head end of the exchanger. With this equipment prepared, you are ready to begin the test.

Remove the shell cover and floating head cover. Replace the floating head cover with the previously prepared rubber sheets and blind flange, and install the shell cover. Remove the channel cover on the opposite end of the exchanger. Connect the hydraulic test pump to one of the shell connections.

Apply sufficient pressure to the test pump to test the shell side with the outlet valve closed. Examine the shell case for water leaks. Now look on the channel end of the tube bundle and you will quickly note the water coming from the faulty tubes. Thus it has been possible to find all of the faulty tubes at once and in the minimum possible time.

Loading and Sampling LPG Cars Can be Done Safely and Efficiently


VALVE STEM PACKING
NEEDLE VALVE
LOADING LINE
VENT LINE
PACKING GLAND MADE FROM EXTERNAL VALVE LUBRICATOR
OPTIONAL SIZE BUSHING TO FIT VALVE ON TANK CAR
STANDARD PIPE 6" IN LENGTH

Important conditions of safety and efficiency are met with this novel device for loading and sampling tank cars. The accompanying illustration shows the details of this successful application of the art of gadgeteering.

An external valve lubricator is modified by drilling out the grease channel to provide space for the insertion of a six-foot length of ½-inch pipe. The plug in the lubricator grease cup is removed; the valve stem packing is then wrapped around the pipe as shown. The lubricator cup is tightened to prevent leakage around the pipe. A ½-inch valve and street ell are attached as shown, and a bead weld is added to prevent the tube from slipping out of the packing gland.

The slip tube assembly is connected to the valve on the vent line with the proper size bushing. The dome is removed to set the slip tube to the desired outage and then replaced. When the proper outage has been attained liquid will flow from the top of the tube. The tube is then pulled out as far as possible, the vent valve closed, and the slip tube assembly removed. Thus, a potentially hazardous operation is concluded with safety and efficiency. Total cost of the assembly is less than $25.

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Sun Oil Company
Delhi, La.

Have You Some Good HOW TO DO IT Ideas?

Here's a chance to share them with others and, at the same time, collect $10 for each one. You don't have to be a writer. Just describe the improvisation, as you would to a friend, using an illustration to put it across. Send your ideas with sketches or photos to Editor, Petroleum Refiner, Box 2608, Houston, Texas. We'll handle the rest. And you profit!

"Loading And Sampling LPG Cars Can Be Done Safely And Efficiently" and "Discarded Auto Wheels Make a Good Rope Hanger" are award winning "Operation Kinks" from the Southern Regional Meeting of Natural Gasoline Association of America which was held in Tyler, Texas, October 24, 1952.

MAINTENANCE / OPERATION

Discarded Auto Wheels Make a Good Rope Hanger

Two discarded automobile wheels can be easily converted into an efficient storage rack for blocks and tackle and rope. The accompanying drawing shows schematically how it is done.

The automobile wheel is cut in half and the two halves mounted approximately 18 inches apart on a wooden or steel panel. The panel in turn is attached to a convenient and easily accessible wall space.

The amount of rope to be stored determines the most convenient distance between the two wheel halves. The top half is mounted rigidly and is provided with a loop for hanging the blocks after they have been drawn together or "two-blocked." The bottom half of the wheel is pivoted on a center bolt.

In storage the rope is coiled firmly around the two half wheels. When the rope is to be removed the bottom half is swung to either side far enough to provide sufficient slack in the ropes to allow the entire coil to be removed without unwinding. When mounted on the hanger, the rope contributes to the neat appearance of a store room and eliminates tangling.

Zack C. Bennett
Continental Oil Company
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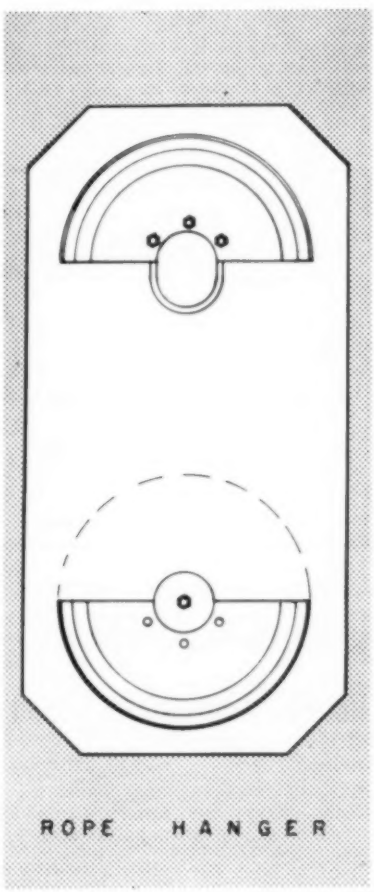

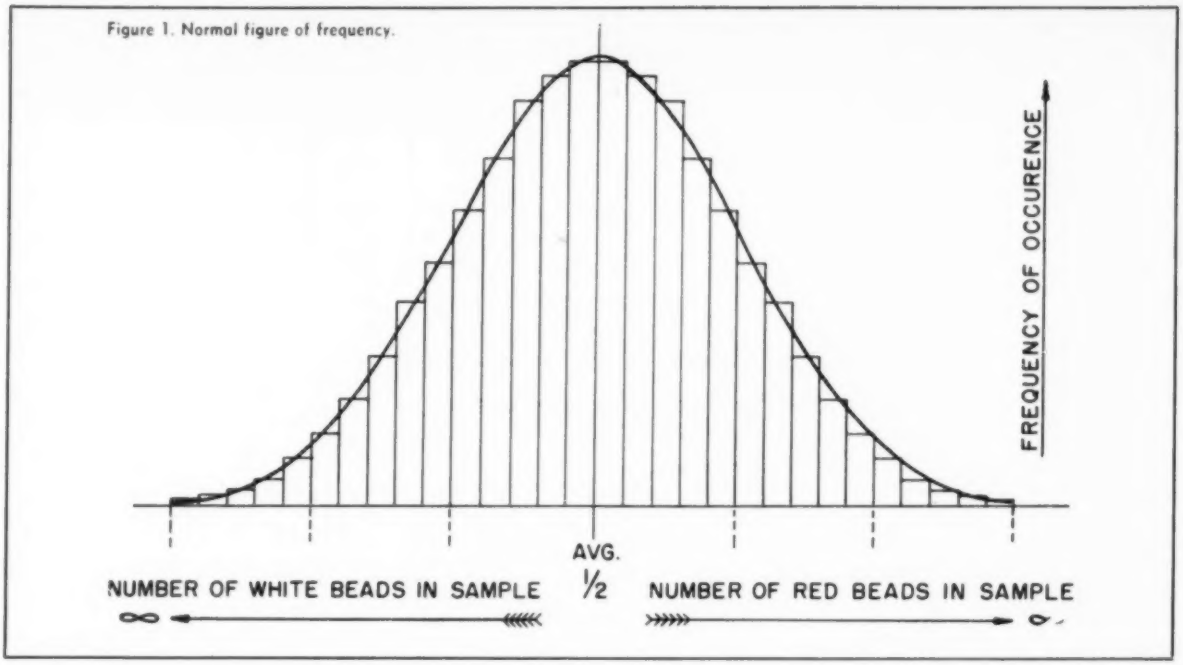

Figure 1. Normal figure of frequency.

Statistical Quality Control—Applications and Limitations

How can you apply this new technique to your operations? Here is a simple, grass-roots explanation

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Magnolia Petroleum Company,
Beaumont, Texas

THE TOPIC OF statistical quality control, a very broad one, has received considerable attention in the postwar years. Highly controversial, any discussion of the topic will generally cover the whole field of statistics. In the approach to any problem there are two phases to consider, 1) the philosophy or theory and 2) the actual mechanics of application. For a better understanding of the philosophy behind statistical quality control it is necessary to start in the field of statistics and before that in the field of probability. Any effort to study the development from the beginning will go back to antiquity.

As long as man has kept records he has been using statistics. In the plural sense the word statistics describes any tabulation or graphical representation of numerical data. Daily reports, bulletins and periodicals usually contain figures on supply, demand, and production of petroleum products. Comparisons will usually be given with the previous weeks, months, or years average and the variation of the averages will be shown. These in the general sense are statistics.

Used in the singular sense statistics describes the methods of organizing and interpreting numerical data. Their beginning also dates with the first time man kept a numerical record for in so doing he was interpreting numbers. As statistical methods are thought of today, however, the development can be traced to about the 19th century. A branch of mathematics began to develop based on the frequency distribution theory as related to the theory of probability. By definition, the theory of probability deals with the objective numerical measurement of probability. The theory of error, or the consideration of the frequency distribution of errors, is the main link between the theory of probability and the theory of statistical frequency.

A demonstration can be visualized which will illustrate these two principles. Assume that a large box contains red and white beads in equal proportions. The probability of drawing a white bead from the box is ½ or 0.5. On a single draw the equal probability of drawing a red bead exists. The total probability is unity, we can draw either a red or a white bead since there are no other colored beads present. The probability of a particular event is measured by a number, 0.5, in this known, equally likely, probability system. In the long run a series of draws will produce the same number of red beads as white beads.

Assume that instead of drawing one bead a sample of 100 beads is drawn. A series of such draws will produce samples with varying proportions of red and white beads. On occasions the sample will contain 50 white beads. A fewer number of times it will contain 45 white beads. A still fewer number of times it will contain 40 white beads. With enough drawings a sample would appear having no white beads. Conversely, a sample would eventually appear having no red beads.

Original presentation of this discussion was before a regional meeting, Western Petroleum Refiners Association, in Beaumont February 13, 1953.

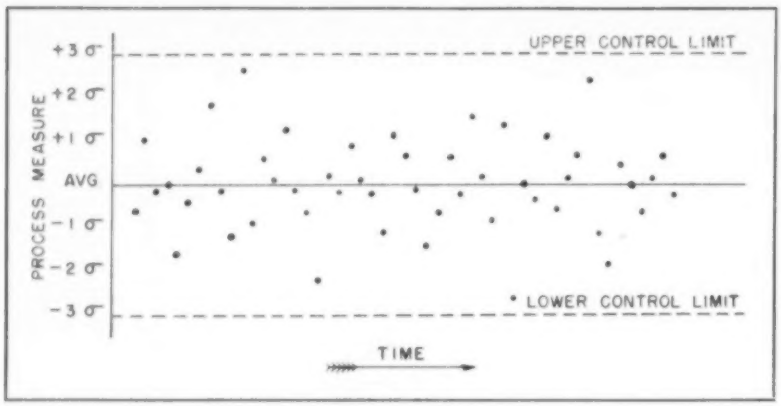

Figure 2. Shewhart control chart.

The possibility of these homogenous draws is so remote that it is staggering to the imagination. Those samples containing approximately ½ red and ½ white beads appear more frequently than others. As the predominance of either red or white beads in the sample increases, the frequency of drawing that type of sample decreases. By keeping a record of the distribution of red and white beads in the drawings and plotting the data on a frequency basis, a figure would be developed which is very similar to that of the normal figure of frequency shown in Figure 1.

In the long run, one half of the drawings will be predominately red, the other half white. The plot will be symmetrical about the mean or average. By assuming that a sample of infinite size could be drawn instead of a sample of 100 beads, the remote points or tails of this figure would extend to infinity. The sample would be of infinite size all red or all white. The curve bounding this normal figure of frequency is the normal curve of error and can be described mathematically. Although the bead drawings were from the same box, drawn in the same manner, the results show that something was different, causing different results. This something is described statistically as "random chance causes," the results of which give the normal curve of error. It is this curve of the frequency distribution of error which links the theory of probability with statistics. The same operation performed under the same conditions gave different results.

This frequency distribution can be described mathematically and other characteristics about it determined. It has a mean or average value. It has a variation about this average value. Statistically, this deviation about the average is calculated as the mean square deviation and is called the standard deviation. The most familiar symbol for standard deviation is the Greek letter sigma, σ.

On Figure 1, the positions of one, two and three standard deviations from the mean are located with dashed lines. These divisions are generally used in dividing the frequency distribution into parts. The total area is unity or 100 percent. The area between plus and minus one, two and three standard deviations from the mean will be equal to 68.3 percent, 95.4 percent and 99.7 percent of the total. Since these areas represent frequency of occurrence for a given chance cause system, the frequency of occurrence above and below a given level of deviation can be predicted.

This ability to predict the range of values with a given frequency is the basis of statistical quality control. Even though there is nothing in real life which is constant, there are constant cause systems. In the bead drawing demonstration the probability of the draw was not altered. The actual drawing procedure introduced "random," "non-significant," "non-assignable" causes of variation which produced the frequency distribution. For that experiment a definite pattern was established and the statistical measure is that of a stable constant cause system of variation.

Before 1942, most statistical quality control applications were made in the electrical manufacturing industry, in the textile industry and in the production of munitions in some government arsenals. In 1942 and thereafter, statistical quality control began to receive some attention from industry as a whole. The statistical frequency distribution was applied to the variation of manufactured products. With the manufacturing process, however, the viewpoint is not the same as with the box of red and white beads. Instead of looking forward and deductively calculating the probability of an event it is only possible to look backward at the pattern already established and draw conclusions. With the stable chance cause system a very definite pattern exists. By accumulating sufficient data the numerical information of that system can be closely approximated.

It was with this concept that the "Shewhart" control charts were developed. The frequency distribution was given a third dimension—time. Successive samples from a stable chance cause system will fall within the same statistical limits as did the drawings of red and white beads from the box. Percentagewise, 99.7 of the samples will be contained within the three sigma limits of the distribution. In other words, only 3 times in 1000 would a process produce a weight, measurement, color or whatever was being controlled, that would fall outside this 3σ control limit. By establishing the 3σ levels of variation as control limits, a person can say with almost moral certainty that the stable chance cause system has changed, or that the machine or process is operating at a different level when a point falls outside these limits. Only 3 times in 1000 would that person be wrong in saying that something was definitely different about the system. A theoretical control chart is shown in Figure 2.

With Regard to Time

Instead of plotting a frequency distribution as was done in Figure 1 the plot was made with regard to time. In effect, the normal distribution is turned on its side and spread out. The same general characteristics seen in Figure 1 can be seen in Figure 2. The data clusters about the mean and becomes less and less frequent as the deviation from the mean increases. Approximately ½ of the data falls above the average. There is a random time pattern since there are no series of runs above or below the average. A rule of thumb in testing for random chance in such a series is that the number of reversals in the trend of successive points should be twice as great as the number of sequences. In Figure 2 this ratio is slightly greater than 2 to 1. All of the points fall within the 3σ limits and the process is said to be in statistical control. It is operating with a fixed pattern of variation.

Direct applications of this control method in the refinery are limited. A generalization can be made that they are restricted to those types of operations which are thought of as repetitive processes. This classification is open to argumentation since no strict definition can be given which will cover all cases.

A boundary or limit is established by considering packaging operations as typical repetitive processes. The filling of 1 and 5-quart lubricating oil cans adapts itself well to this theory of a stable chance cause system. It has been pointed out[2] that the problem of overfill and minimum guarantee volume was readily answered with the statistical concepts. A similar problem exists in controlling the weights of wax cakes made in automatic molding equipment. Statistical control answers the question, "What is the variation inherent in the process?," and establishes the minimum level of overweight which will maintain a guaranteed weight. Whether the filling process be controlled by positive displacement plunger, meter, weight, level or any other type of measurement, the type of operation is repetitive and statistical quality control will define the pattern of the system.

Another type of operation which can be classified as repetitive is that of control testing. Just how accurate is a test? Answers to that question are very important to the refinery since very many operational decisions are made for differences in quality measurement within the accuracy of one test. Fortunately, in most cases, when the time for decision is at hand, more than one test result is available. The final decision is made on an average value reported from several tests where the accuracy or variation from the true value is inversely proportional to the square root of the number of tests. If σ is the estimated variation of a test method, the accuracy of the average result of four tests performed on the sample is $\frac{\sigma}{\sqrt{4}}$ or $\frac{1}{2}\sigma$. Accuracy is defined as the possible difference between the reported result and the true value of the sample. Another way to express this would be to state that a test result is never wrong, it can only be different from an unknown true value. Our judgment about this true value can be more or less probable, depending on the variation of the test and the number of tests performed. With the very close margins under which the refiner operates it is quite important to know the variation to expect in the actual testing.

Occasionally in checking for variation in a certain test method, it appears that operators report results differing from those reported by other operators. This could be significant or it could be caused by random chance errors. In statistics there is an excellent technique known as the analysis of variance, for resolving such a problem. By having five operators test a sample six times each, the results could be set up in the analysis of variance as shown in Figure 3. These are coded numbers from an actual experiment. The results are grouped by operators. The sum of the results of each operator and the grand total is obtained. Three factors are then calculated, 1) the sum of the squares of the individual measurements, 2) the sum of the squares of the total for each operator divided by the number of tests for each operator and 3) the grand total squared divided by the total number of tests. The analysis of variance compares the difference of results between operators with the test accuracy or unexplained variation. The measure of variation between operators is the difference between factors 2 and 3. The measure of total variation is the difference between factors 1 and 3, the individual versus the total. The unexplained variation or residual is determined by difference. The degrees of freedom or chances of variation are then listed for each source of variation.

	OPERATORS					
	A	B	C	D	E	
TEST RESULT	35.0	36.0	35.2	36.5	36.7	
	35.0	36.5	36.0	35.5	35.5	
	35.8	36.5	35.5	36.5	35.1	
	36.5	37.0	35.5	36.4	35.1	
	36.5	37.0	35.8	35.5	35.5	
	34.5	34.3	36.0	35.5	35.5	
TOTAL	213.3	217.3	214.0	215.9	213.4	1073.9

1) Σ (INDIVIDUAL RESULTS)^2 = 38,456.43

2) $\frac{\Sigma\ (\Sigma\ \text{COLUMN TOTALS})^2}{6}$ = 38,444.09

3) $\frac{(\text{GRAND TOTAL})^2}{30}$ = 38,442.04

SOURCE OF VARIATION	SUMS OF SQUARES	DEGREES FREEDOM	MEAN SQUARE	RATIO	F RATIO 5%	F RATIO 20%
OPERATORS (2-3)	2.05	4	0.5125	1.038	2.60	1.62
RESIDUAL	12.34	25	0.4936			
TOTAL (1-3)	14.39	29				

Figure 3. Analysis of variance.

For the total experiment there are 29 degrees of freedom, one less than the total number of tests. In comparing operators there are 4 degrees of freedom since we have five operators. This leaves by difference 25 degrees of freedom for the unknown residual. The sums of squares divided by the degrees of freedom are the mean square deviations. The ratio of the mean squares is then a comparison of the variation between operators and the variation of the test. This statistical measure is called the F ratio. Statistical tables are available showing the significant levels of such ratios. In this example the 5 percent and 20 percent significant levels are shown in the table. The ratio of operator variation to test variation is so small that it is below the 20 percent level. A decision that the operators are different would be false more than 20 percent of the time. The 5 percent level of significance is generally used for this type of comparison. At this level it is quite likely that the cause for the differences between operators could be found.

For those refiners conducting experimental work the analysis of variance has another application. Instead of looking for significant differences between operators we might just as well have been looking for significant differences between experiments. If the variable being studied was temperature, we would have grouped the experimental data according to temperature rather than operator. The mechanics would be exactly the same. The variation in the experimental result caused by temperature would have been compared to the residual or unexplained variation. An estimate could then be made of the significance. This technique of grouping data, and comparing assigned causes for variation with the unassigned causes is the basis for statistical experimental design. By conducting a block of experiments in such a way that the data may be grouped and regrouped according to other variables it is possible to check for effects of more than one variable

1. DISTILLATION

$$\text{KEROSINE END POINT} = 5.497(\%\,\text{KERO.}) + 0.581(\text{KERO DRAW TEMP.}) + 0.858(\%\,6.0.) - 0.321(\%\,\text{RED. CRUDE}) - 3.539(\%\,\text{GASO.}) + 305.2$$

2. ALKYLATION

$$\text{LIGHT ALKYLATE OCTANE} = \text{3-C} + 4\,\text{CC T.E.L.} = 2.89\,\frac{\left(\frac{C_4^{=}}{10}\right)^{.3753}\left(\frac{I}{O}\right)^{.170}\left(\frac{\%A}{10}\right)^{3.069}\left(\frac{R}{1000}\right)^{.0306}\left(\frac{E}{O}\right)^{.2248}}{\left(\frac{90\%}{100}\right)^{.4855}\left(\frac{D}{O}\right)^{.0841}\left(\frac{T}{100}\right)^{.5156}\left(C_5\right)^{.0941}}$$

Table 1. Typical refinery empirical equations.

within any block of experiments. The technique has had its greatest application in the fields of biological, agricultural and medical research. The refiner, in his early stages of experimentation on an unknown process, may find it advantageous to use this analysis of variance in identifying the factors having a major effect on his process. His experiments can then be concentrated on evaluating these major variables and determining the nature of their effects with empirical equations or graphs.

The operations considered thus far have been of the repetitive type, in packaging and testing. To the refiner the biggest control problem lies in his processing units. How well can these units be controlled, and what will statistical quality control methods do toward this end? To my knowledge there have been no successful direct applications to these processes. The fundamental concepts of the constant cause system cannot be employed. The "random," "nonsignificant," "nonassignable" causes of variation are so overshadowed by the "non-random," "significant," "assignable" causes that they cannot be directly evaluated. From the standpoint of statistical quality control this problem resolves itself into two phases. The first phase is an evaluation of these assignable causes in terms of their effect on the product in question. This is usually done with an empirical equation. The second phase is the application of statistical methods to determine the degree of accuracy of the empirical equation. This is then a measure of the unassigned causes of variation, and is called the standard error of estimate of the equation. Two empirical equations developed for processing units and recently published are shown in Table 1. They refer to distillation and alkylation processes. The distillation process[1] was simple fractionation of East Texas crude oil to produce gasoline as an overhead product; naphtha, kerosine and gas oil as side draws; and reduced crude as the tower bottoms product. The empirical equation was developed to predict the end point of the kerosine fraction from the temperature of the kerosine draw and the percentage yields of the different streams. After developing the equation the "goodness of fit" was established statistically. For this particular equation the standard deviation of the calculated end points as compared with the observed end point is 6 F. The second equation relating alkylation variables with octane is a little more complex.[2] Nine variables were correlated with the octane number of the light alkylate. Symbols in the equation are as follows:

- S — Light alkylate octane number, 3-C + 4cc TEL
- $C_4^{=}$ — Butylenes in olefin charge, volume percent.
- $\frac{I}{O}$ — External isobutanes to olefin volume ratio.
- %A — Average acidity in reactors, weight percent.
- R — Total reactor charge, B/D.
- $\frac{E}{O}$ — Volume ratio of emulsion circulation to olefin charge.
- 90% — 90 percent distillation point of light alkylate, ° F.
- $\frac{D}{O}$ — External diluent to olefin volume ratio.
- T — Average reactor temperature, ° F.
- C_5 — Total C_5's in charge, volume percent.

The standard deviation of the data from this equation was found to be 0.3 of the 3-C octane rating at 4.0cc TEL. These equations are shown as typical examples of the results obtained on processing units. The difficulty of applying the random chance cause system to the processing units can be seen from the complexities of these equations. The first step of evaluating the known causes of variation is in itself a major problem. When the equipment and the controls for the equipment reach the stage of development where there are no more assignable causes for variation, we will be able to apply statistical quality controls directly to these units. Until that time, however, studies along this line will have to use an indirect method in an attempt to improve the process and the equipment itself.

Summary

In summarizing the applications and limitations of statistical quality control for the refiner we might consider it as a tool. It is a mathematical means of measuring random chance variation, or the estimation of average error. For every operation in the refinery there is a certain amount of random chance variation. This will vary from plant to plant, unit to unit, and batch to batch. In a broad sense the possible applications might be limitless. To the refiner, however, such a concept is entirely too broad. His problem is to determine in which of his processes chance variation is significant. Our studies have shown that only the repetitive type processes fall into this category. The major variations in the processing units are the results of assignable causes. In applying this statistical tool to the processing units it is necessary to first, evaluate the assignable causes of variation and then apply the language of statistics to measure the remaining unassignable chance causes of variation. The development of this approach is still on the drawing board. Empirical equations have their limitations. They are only as representative as the data from which they were developed. They are only as accurate as the choice of the original equation to which the data was fitted. At present such relationships are in the hands of the engineers who are developing them. Increased control of the processing units through application of such methods by the unit operators is not foreseen in the immediate future.

ACKNOWLEDGMENT

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* * *

Catalyst Poisons— And What to Do About Them

A Panel Discussion

Catalyst poisoning is costing the nation's refiners millions of dollars annually in the operation of their catalytic cracking units. The highly interesting panel discussion presented here took place at the Casper, Wyo., meeting of the Western Petroleum Refiners Association. The panel members represented all phases of the oil refining industry, including research, design, construction and operation. The participants were

C. L. Allison, Socony-Vacuum Oil Company, Inc., Chairman, Casper, Wyo.
Davis Read, Universal Oil Products Company, Chicago.
A. W. Hoge, Houdry Process Corporation, Philadelphia.
J. P. Shambaugh, Socony-Vacuum Oil Company, Inc., New York.
A. D. Fischbeck, Phillips Petroleum Company, Bartlesville, Okla.
A. G. Zima, International Nickel Company, Los Angeles.
J. R. Penisten, Frontier Refining Company, Cheyenne, Wyo.
Richard Carlton, Shamrock Oil and Gas Company, Sunray, Texas.
Melvin Morrison, Socony-Vacuum Oil Company, Inc., Augusta, Kan.

Our readers are enjoined to remember that the portion of the discussion given below is reproduced exactly as the panel members delivered their comments; hence, the material is not written in the usual style of a technical article.

* * *

QUESTION: Under the conditions of a metal contaminated catalyst, have you had any experience of the effect of the catalyst on the gasoline stability?

Davis Read: We know that the poisoning of a catalyst is brought about by these metals, that the catalyst loses selectivity, and becomes more like a dehydrogenation catalyst under the influence of certain of these contaminants which will tend to make the gasoline somewhat olefinic and possibly even di-olefinic if carried to a far enough extent. And that might of course have some effect on the stability of the gasoline. Although we have no actual quantitative data on it, we do know that the contaminants, certain of them, make the cracking catalyst act more like a dehydrogenation catalyst. Of course that whole question of stability—tying it in with the olefin content—is not a very good one actually because polymer gasoline is quite olefinic and it is also quite stable. But when you do have the di-olefin present, which may come along with the olefins, they do tend to increase in stability.

A. D. Fischbeck: I might say that we operate, I believe, with a bad metal poisoning problem and we have no direct evidence that it affects the gasoline stability. We have a lot of evidence of metal poisoning (in Kansas City unit), but we have no direct evidence from a commercial unit that it does affect the gasoline stability.

Read: Did the gasoline get more olefinic?

Fischbeck: Not appreciably so; not enough that you could directly tie it down. There are so many variables, it is hard to specifically determine cause. We tried to definitely answer that question but could not.

Read: We have actually, in pilot plant work shown the effect of metals on the olefin content by taking a Kuwait gas oil which is a very highly contaminated stock and putting it through a catalyst from a commercial unit which had certain contaminants on it and another catalyst which did not have contaminants on it, both equilibrium catalysts. We did observe that the olefin content of the gasoline at the same conversions and same operating conditions was some 20 or 30 percent higher when it is produced or was produced from the catalyst that was contaminated. We have run with catalyst having as high as one percent iron plus other heavy metals on it and, though we have made no test to determine the effect on gasoline stability, there was none that you could notice on the routine tests, on finished gasoline.

A. W. Hoge: Operating with catalyst with that much contamination, you do though get a major shift in product distribution, I presume?

Read: Yes, you make more gas, lower molecular weight gas. More conversion to the same gasoline. That's another evidence of dehydrogenation.

QUESTION: Does the form of iron make any difference in the contamination level? Whether it's been put in there through the crude or whether by erosion? We are under the impression that iron from erosion does not necessarily hurt the catalyst.

Read: That has been our experience.

Hoge: That's right. You can have a catalyst that is pretty well rouged with iron oxide dust and still does not behave too badly. On the other hand a natural catalyst with fairly high inherent iron content activated by means of sulfur may behave very badly.

Richard Carlton: We had that experience recently. Our catalyst showed an iron like coating for several days, apparently picked up from the unit and we had no noticeable difference in our conversion or percent gasoline and we lowered our burning temperatures and it cleared right up. That just serves to verify the fact that iron from the unit does not affect the conversion as much as iron in the oil.

J. P. Shambaugh: I can't quite agree with that. We had an experience back about five or six years ago where we did get some white beads contaminated with iron and we were running some high sulfur stock. It didn't show up so much in the commercial action, commercial results, but it did show up pretty strongly in our activity checks on the catalyst, but that iron wore off in a matter of about a week or two. It was all right from then on.

Carlton: Our last activity check was probably a percent lower than normal so that could be it. We didn't run any special tests on the products other than the routine analysis and they didn't show up anything.

Hoge: That is also borne out by other data. For example, synthetically, heavy metal oxides may be mixed with a given catalyst, in a number of different ways and the same concentration of metal oxide in those preparations will cause different effects on the cracking reaction.

QUESTION: I have some questions here that were sent in in advance and one of these is, "What metals are known to poison silica alumina fluid catalyst?"

Read: I think Mr. Wainright covered that pretty well there in his talk. I think nickel and vanadium and iron, copper and sodium are probably the worse offenders.

QUESTION: Has anyone had any experience with magnetic iron, in catalyst? In Billings—I think it has dropped off now—but we had an unusually high percentage of material that was magnetic. It could be extracted with a magnet. You couldn't tell any particular effect from it in the units. I was wondering if anyone else has had that experience.

Read: I don't know of any case of that kind, but there might well be. I am not familiar with it.

QUESTION: I notice the absence of lead in this list. Has there been some operation with high lead in feed stocks and no contamination?

Read: As far as I know, there is. We don't find very much lead in these feed stocks. We haven't considered it to be a very serious problem in catalyst contamination.

J. R. Penisten: At the time we had about one percent iron on the catalyst. We had 0.015 percent lead, which is quite a bit higher than normal. I don't know what the separate effect of the lead was, but there is appreciable amount. Jim, do you know of any cases in that?

Shambaugh: No, I hadn't heard of it at all. In fact, we haven't gotten too seriously bothered with metal problems. Of course, they are a problem, but I hadn't heard of lead at all.

Read: I want to tell of one experience we had in which of course metals are present in the feed stocks and one instance where we were investigating a particular commercial problem, we picked up traces of things like antimony and lead which later proved to come from the laboratory apparatus in which the stuff was being tested and, until we got around to using glass equipment, etc., that was a confusing factor.

Penisten: We had one analysis on a vacuum gas oil (Wyoming crude) which shows between two and 7/100 of a part per million of lead in it, which is pretty small.

QUESTION: What are significant amounts of poisonous metals in feed stocks?

Fischbeck: I'll say that any amount of vanadium and nickel is significant. One-half part per million is troublesome and we are really in for trouble if vanadium or nickel ranges up to 1½ parts per million. The three cat crackers that we operate of the Fluid type all have the same amount of nickel in the feed. It runs from two to 3/10 parts per million, but the vanadium varies from 1/10 parts per million at the Borger plant and 3/10 parts per million at Sweeny to about 1.4 parts per million in the Kansas City unit. We have very little if any difficulty at Sweeny, Texas, and only a moderate amount at Borger and "old Billy Hell" at Kansas City. Most people think of nickel as the one giving the most trouble. In our case it is vanadium, but I do not know what it would be if we turned those percentages around and say that we had a constant amount of vanadium and varying amount of nickel. We probably would have the same difficulty. We have shipped catalyst from Borger to Kansas City to keep catalyst activity up. In our case the catalyst poisoning means the loss of about one-half million to a million dollars per year. This loss is reflected in product distribution, reduced fresh charge and many other ways; so it is a real problem. We formerly attributed the presence of the catalyst poisoning metals in feedstocks to entrainment. Later, we found evidence of metal compounds distilling over in very heavy gas oil fractions. I understand some people using synthetic catalyst do not have this trouble, but on natural catalyst we really have it.

Question: On this Wyoming type crude, I think any refiner would be doing exceptionally well if he could get those metals down in that range.

Fischbeck: We are terrifically concerned with any metals. We're in business to make money.

Shambaugh: Our Casper operations here, our total feed to the TCC has metal contents just about the same as what you're running and we have been watching it very carefully, but I think Charley will agree that as yet there has been no commercial results, any indication of any trouble from this metal poisoning. However, we have been able to find that there is little bit more hydrogen from the laboratory test of the catalyst. That is in the total feed here at Casper; so I think our fresh feed is about double that quantity. Probably on the order of about 6/10 parts per million nickel and may be about five parts per million of vanadium.

QUESTION: Wouldn't that amount lead you to believe that the metals effect the fluid catalyst?

Shambaugh: We had a little bit of proof that the metals appeared on the outside of the feed catalyst. We have made one test in which we ground off the outside one percent weight of the bead catalyst, and found that it contained six times as much metal as the whole bead catalyst did. We are trying to find out a little bit more about that to see if we can find out anything about the mechanism of it. We don't have very much iron in our feed stocks. We've run into iron as far as Socony's catalyst is concerned only once that I know of and that was the occasion I was mentioning at Paulsboro. It may be that we have feed stocks that don't contain any appreciable amount of iron and I think that iron in large quantities is apparently pretty severe.

Read: It might be of interest along that line, Jim, about the difference between fluid and Socony. I think that Bob Penisten here has an analysis of this heavy Wyoming gas oil for comparison with what is being charged here at Casper. It might be more correct comparison than what you were comparing with Dale's Kansas City operation.

Shambaugh: That's quite possible that the actual amount of metals may not be as much of a problem as the type of crude that they come from. I don't know. Do you have anything on that at all?

Answer: That probably might have a bearing on it, but we think that the amount of the metals that you put in to the unit and of course the replacement rate in which you are replacing the catalyst. In other words, how much you can clean up this catalyst and take out the metals that are coming in by replacing with fresh catalyst. It has a very big effect on your operation there and I think in general that the fluid operations would have charged somewhat heavier stocks there than have been charged to the Socony. What I was getting at, this comparison and of course this replacement rate on normal fluid operation, which we have in the post war designs have had replacement rates which are quite low, under 25 per 100 pounds per barrel of fresh feed. The higher that replacement figure is, of course, the less effect the contaminants will have on the product distribution.

Shambaugh: I think that adds up to saying that there is a level at which you can maintain the metal on the catalyst before you can get into trouble, doesn't it? Irrespective of replace-

ment rate or anything like that before you exhibit high hydrogen production and higher coke production, reduction of activity in that manner. In other words, we are trying to look at it from the angle of "Yes, it requires replacement," but to determine how much replacement you get to is a question of what metals concentration you can tolerate on the catalyst.

Read: Well, that's true. As Dale says the less the better. Now I don't know if you have the figure on the Casper feed stock, showing the nickel and vanadium that's in them.

Shambaugh: I was just quoting them, they are running about 4/10ths part per million of nickel of the fresh feed and about four to five parts per million of vanadium.

A. G. Zima: Do you notice any difference in the sulfur content of your feed as your nickel contamination goes up?

Shambaugh: It doesn't tie into the type crudes. Some crudes may have high sulfur content and low metals and vice versa.

Zima: The reason I asked that question, nickel occurs in nature primarily as a sulfite. I was thinking, perhaps, is a sulfur a serious content.

Shambaugh: Well, the sulfur is quite high here at Casper. I think the fresh feed is around 2 percent or thereabouts.

QUESTION: Your nickel may be the vehicle or iron also copper can be the vehicle on which that sulfur is brought in?

Shambaugh: Well, there are other stocks that have higher sulfur contents that do not have the metal contamination.

Question: That is because metals are absent in that area. Metals are there, you can bank on it, and they are tied up with the sulfur.

Answer: That's quite possible. Do you agree with that, Dave?

Read: Yes. Getting back to this other, what do you have there on nickel and vanadium and heavy gas oil; say 24-gravity vacuum gas oil from Wyoming crude. You were reading those off a minute ago.

Penisten: The nickel, the lower limit, was 3/100, the upper limit was 15/100 parts per million, vanadium was 2/10 to 7/10 parts per million, the iron ran 1.2 to 5.0.

Question: That's about a 23 or 24-gravity heavy vacuum gas oil?

Penisten: Yes.

Question: How does that compare with Casper operation?

Question: Did you say that the nickel was 0.3 to .5 nickel?

Penisten: No. It was 00.3 to 0.15.

Question: That's parts per million? That's the limits of the analysis.

Irradiation on Lubricants Being Tested—

View of gamma radiation unit being used by California Research Corporation, subsidiary of Standard Oil Company of California, to test the effects of irradiation on lubricants and other materials likely to be exposed to radioactivity in an atomic engine.

The radioactive "source" of 14-inch section of two-inch cobalt tubing, is housed vertically in the drum-shaped lead shield at the center of the photo. Shield weighs two tons.

Operator at left removes long "plug" from the shield by remote control mechanism, preparatory to inserting test material to be exposed to radiation. Door at right is open for photography purposes only. It normally remains closed.

Shambaugh: Our analysis on nickel shows the total feed to the Casper unit as being on the order of 2/10 to 3/10 and we are running a recycle ratio of about, what is it—1¼ to 1, one part of recycle to one part of fresh feed, is that right?

Answer: It is a little higher than that now, 1.35 to 1.

Shambaugh: The total feed then is about 2.35 to 1 part of fresh feed, so that would mean that the fresh feed and the gas oil that we are running has a nickel content that of about 4 to 5/10th parts per million and vanadium content is about 4½ to 5 on the fresh feed parts per million.

Penisten: By far the largest amount of metals goes in with the crude charge, probably, I don't have the figures on the crude.

Question: That's right. This was taken at about a year ago, I guess, where this Nieber crude which is being put into their unit at Frontier, all the crude goes into the catalyst. You don't have a vapor separator ahead of you to take the bottoms out of anything. It all goes through there.

Shambaugh: Considerably lower on the ashing technique than on the spectroscopic determination. I'm not familiar with the whole procedure that you go through with on this.

Read: You don't use a spectrograph at all in this wet ashing technique? I don't know the whole technique either.

Shambaugh: Anybody here from Casper know the way we do that? Ray Loomis, do you know the technique of that?

Ray Loomis: You finish up with the spectrograph. That's the primary reason for doing it. It may have been changed. That's about the only way when you get into parts per million.

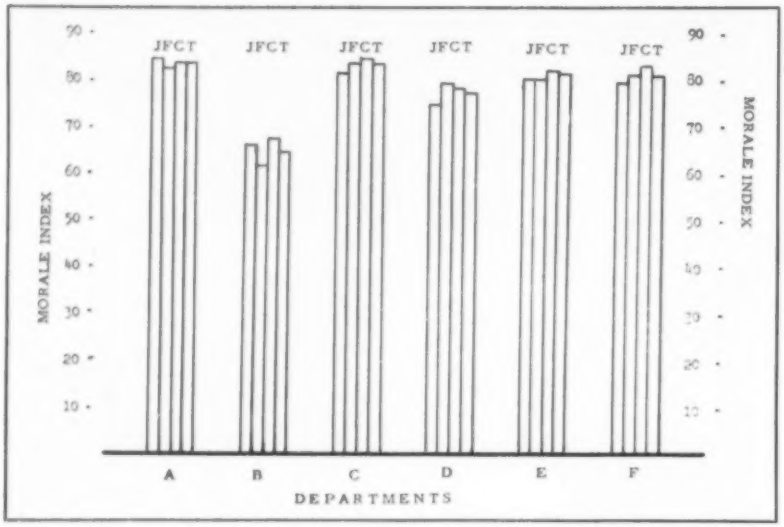

Figure 1. Morale of six departments: Attitude toward J—job; F—foreman; C—company and T—Total.

Measuring Employe Morale

Here's another of Mr. Benge's articles on employe relations, stemming from 11 years' experience in the oil industry plus 13 years as a management consultant.

Eugene J. Benge
Hu-Management Engineer,
Asheville, N. C.

WE'RE JUST one big happy family, a Philadelphia industrial executive told me. "I know my people by their first names, lend them money when they're in a jam, ask about their babies. Attitude survey? I don't need it."

That was 11 years ago. I thought of my executive friend recently, on a train ride from Washington to New York. Three months after he had reassured himself to me, his employes went on a protracted strike, smashed every window in the plant—first names, loans and babies to the contrary notwithstanding. Jobs in the area were plentiful; when the strike was settled only about one-third of the employes returned. Within a year the plant was sold; within three more years it was abandoned. From my train window I could see it—a ghost plant, monument to a cocksure executive who proved to be wrong.

In a sense, the story symbolizes all industry. All executives have been wrong, some more than others—wrong in their ideas about morale building factors. For years, they placed their bets on pay: "give 'em high pay through incentive pay plans, and good morale must follow, as night follows the day."

But it didn't. Security was next: "give 'em security; that'll lull them into high morale."

But it didn't.

A Lot of Little Things

And for a simple reason: morale is a lot of little things. It is not bought with pay—or security—or grievance machinery, communication, education, posters, suggestion systems, group insurance, pension plans or any one of the hundred-and-one other panaceas. These are facets of the problem—but as with a diamond, each facet has to be polished.

In one frequently quoted study employes were asked to rank eight factors in order of importance to them; their bosses were separately asked to rank the same factors from the employes' standpoint. Results are shown in Table 1.

TABLE 1

FACTOR	IMPORTANCE AS RANKED BY	
	Bosses	Employes
Credit for work well done	7	1
Interesting work to do	3	2
Fair pay and salary increases	1	3
Understanding and appreciation	5	4
Counsel on personal problems from superior	8	5
Promotions on the basis of merit	4	6
Physical working conditions	6	7
Job Security	2	8

Morale Factors

Morale, then, is not a single emotional response, but is rather the composite of many responses, some favorable, others unfavorable. By measuring specific *attitudes* toward many work situations it becomes possible to combine them into *morale indices*.

Usually an employer is interested in how his employes feel toward three major situations:

1) How does the employee feel about his job?
   - A) Lighting
   - B) Ventilation
   - C) Fatigue
   - D) Hazards
   - E) Tools and equipment
   - F) Compensation
   - G) Security
   - H) Opportunities for advancement
   - I) Demands upon his highest abilities
   - J) Fellow employes

2) How does the employe feel about his boss?
   - A) Technical fitness for the job
   - B) His fairness
   - C) Support for subordinates
   - D) Handling of complaints
   - E) Openness to suggestions
   - F) Discipline
   - G) Consistency
   - H) Planning of work
   - I) Teaching ability
   - J) Dynamic leadership

3) How does the employe feel about his company?
   - A) Management
   - B) The personnel department
   - C) Individual executives
   - D) Individual personnel policies
   - E) Individual personnel practices
   - F) Reputation
   - G) Quality of its product
   - H) Community participation
   - I) Financial stability

The "Opinion Ballot"

Let us suppose that the Potent Refinery wants a morale survey and agrees that reactions to the 30 items listed above would be of great interest to management, and these are incorporated in a questionnaire, or opinion ballot. Each item is phrased as a question with five possible gradations of response, as in the following example:

How well does your foreman disci-

pline employes who deserve it?

( ) A. He bawls them out in front of other employes
( ) B. He uses sarcasm in front of other employes
( ) C. He is quite direct, but takes employes aside
( ) D. He criticizes in private, and explains why
( ) E. His criticisms are always helpful and never given in the presence of others

Here's another, used to check an attitude toward the company:

When you tell your friends what company you work for, how do you feel?

( ) A. Ashamed to admit it
( ) B. Not especially happy about it
( ) C. Neutral about it
( ) D. Glad I don't work for certain other companies
( ) E. Proud to tell it

The opinion ballot usually consists of an 11- by 17-inch sheet, folded to provide four printed pages:

Page 1—Part A. Careful explanation for employes of objects of the ballot, instructions how to fill it out.

Part B. Check lists for the employe to indicate department, shift, sex, age group, earnings group and years of service group.

Pages 2 and 3—Part C. The 30 questions with multiple choice answers like the two illustrated above.

Page 4—Part D. Specific questions about cafeteria, athletic club, credit union, employe paper, etc.

Part E. Space for writing out suggestions or complaints not adequately covered by his check marks in Part C and D. Normally one-quarter of the group take advantage of this opportunity.

Employes are brought together in the club house, cafeteria, or other meeting place—usually in groups of 25 or more. The object of the survey is explained to them. They are provided with pencils and blanks, and allowed to fill in their ballots leisurely. No supervisors are present.

When an employe has completed his ballot, he folds it, drops it into a locked ballot box and goes back to his work. The balloting usually requires about 40 minutes for each group.

Next comes the statistical analysis—detailed mathematical work involving punched card computation of morale indices according to:

1) Each of the 30 items, and these in turn classified according to:
2) Each department
3) Shift
4) Sex
5) Age
6) Length of service
7) Earnings

WE ASKED YOU!
YOUR OPINIONS
OF YOUR COMPANY AND YOUR JOB
Study of Employee Opinions Conducted for
The Champion Paper and Fibre Company
by Benge Associates

Figure 2. Cover page of management's report to employes. See also Figure 3.

By grouping and averaging the questions, it is possible to tell how employes feel about their

1) Jobs
2) Bosses
3) Company

and to make these summarizations for department, shift, sex, age, length of service and earnings.

There are many cross comparisons possible among these various factors. Charts are drawn to illustrate the significant findings and a report prepared, stressing the high and low spots of morale. Special emphasis is placed upon low morale—the report points out in which department and shift it exists, whether it is largely among men or women, young or old, long service or short service, low earning or high earning employes; also which of the 30 items are causing it. Suggestions as to remedial action are given.

Computing Morale Indices

In summarizing results, it would be feasible merely to compute the percentages of employes checking each response. Thus two departments having ten employes each might show the responses indicated in Tables 2 and 3 to the above question on disciplining employes:

TABLE 2
Department A

Response	No. of Employes	Percent
A	0	0
B	0	0
C	1	10
D	5	50
E	4	40
	10	100

TABLE 3
Department B

Response	No. of Employes	Percent
A	2	20
B	3	30
C	4	40
D	1	10
E	0	0
	10	100

It is evident at a glance that the employes of Department A approve the handling of criticisms by their foremen; those in Department B disapprove. However, it is difficult for the human mind to compare so many figures. We need a single index for each question, a composite of responses. Such an index can be computed by allowing 100 points for the highest response, and 20 for the lowest, as shown in Tables 4, 5.

TABLE 4
Department A

Response	No. of Employes	Value	Extended Value
A	0	20	
B	0	40	
C	1	60	60
D	5	80	400
E	4	100	400
Total			860
Average (morale index)			86

TABLE 5
Department B

Response	No. of Employes	Value	Extended Value
A	2	20	40
B	3	40	120
C	4	60	240
D	1	80	80
E	0	100	-
Total			480
Average (morale index)			48

We are now in a position to state *how high* is the attitude of employes in Department A toward supervisory discipline (index of 86) in comparison with that of employes in Department B (index of 48).

Index numbers can then be combined in various ways, to yield a summary like Table 6, which for brevity shows but four of the usual six factors:

TABLE 6
Summary of Morale Indices
Company X

FACTOR	MORALE INDEXES			
	Job	Foreman	Company	Total
Dept.:				
A	84	82	83	83
B	66	61	67	64
C	81	83	84	83
D	74	79	78	77
E	80	80	82	81
F	79	81	83	81
Shift:				
Day	69	73	77	72
2nd	68	76	80	75
3rd	73	79	81	78
Sex:				
Male	68	75	78	74
Female	72	80	82	78
Age:				
Under 20	76	74	78	76
20-24	64	66	70	67
25-29	70	72	76	73
30-34	71	78	78	76
35-39	73	81	79	78
40 and over	74	78	84	79

Sometimes it helps in comprehend-

ing the data to chart them, as illustrated in Figure 1.

Some Typical Findings

What can a company hope to discover that it doesn't already know? Here are some illustrations taken from our files:

A textile company. Its main plant was in the south. The survey revealed two very weak departments, one previously unsuspected; one very strong department, whose head was promptly promoted. Older men, and men longer in service, thought poorly of their foremen; long time executive and foremen training programs were initiated. Men over one year of service, but less than five, had lower morale scores toward virtually all subjects; special steps were taken to soften this "period of disillusionment." Although the management had prided itself on its internal promotion system, employes generally thought it was pretty poor. Steps were taken to tell employes about promotions; aptitude testing was established. These, and numerous other findings, resulted in the organization of a well planned personnel department.

A machine tool company had cultivated employe relationships for many years. It was interested to learn whether its efforts had been effective—or whether it was just kidding itself. The survey revealed a few weak spots—but for the most part gave abundant evidence that the work of many years had not been in vain.

A branch plant was located in the heart of a district seething with labor unrest. Employe demands were unreasonable—the plant was already losing money—management was prepared to shut up the entire plant and transfer production to other plants. Labor handling by the local management had, for years, been atrocious. The survey revealed a great many sources of bad morale, but, alas, too late. Employes struck—the plant never reopened. A survey six months earlier might have saved that situation.

Applying the Results

Obviously, something should be done about the findings of an attitude survey. Actions to be taken are normally of three kinds:

1) Situations where poor attitudes are justified should be corrected.
2) Poor attitudes toward situations which management, after sober reflection, feels to be right indicate a need to sell employes as to their correctness.
3) Strong favorable attitudes toward people, policies or practices should also be studied in an effort to comprehend the probable influences which have brought them about.

Some managements present a report to employes, giving the findings, good and bad. Figures 2 and 3 show cover and inside pages of such a report.

It is considered good practice to form small temporary committees of employes, or of employes and supervisors, to review what can be done to improve weak conditions brought out. Typical committees are:

Safety
First Aid
Lunch Room
Working Conditions
Communication
Internal Promotions
Seniority
Suggestions
Grievances

Or, departmental committees can be set up to consider how the weak morale factors of each department might be improved.

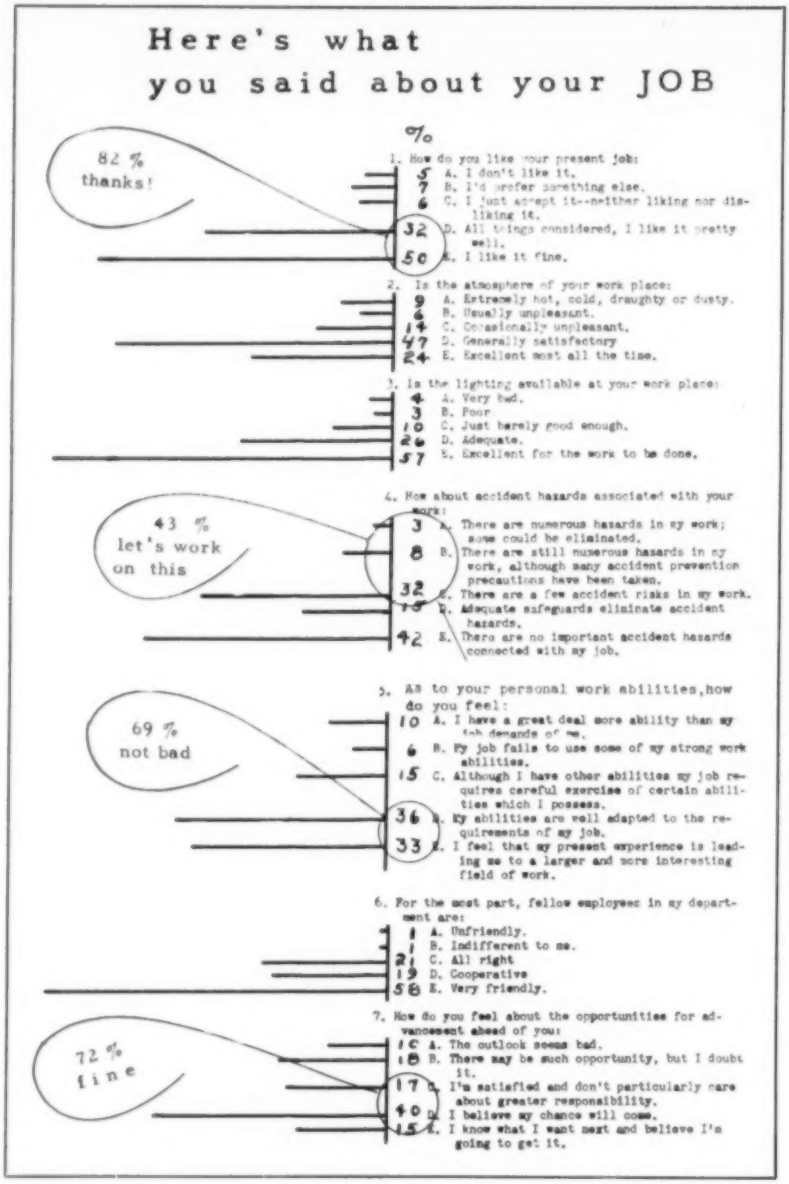
Here's what
you said about your JOB
%
82 % thanks!
1. How do you like your present job:
5 A. I don't like it.
7 B. I'd prefer something else.
6 C. I just accept it--neither liking nor disliking it.
32 D. All things considered, I like it pretty well.
50 E. I like it fine.
2. Is the atmosphere of your work place:
9 A. Extremely hot, cold, draughty or dusty.
6 B. Usually unpleasant.
14 C. Occasionally unpleasant.
47 D. Generally satisfactory
24 E. Excellent most all the time.
3. Is the lighting available at your work place:
4 A. Very bad.
3 B. Poor
10 C. Just barely good enough.
26 D. Adequate.
57 E. Excellent for the work to be done.
43 % let's work on this
4. How about accident hazards associated with your work:
3 A. There are numerous hazards in my work; some could be eliminated.
8 B. There are still numerous hazards in my work, although many accident prevention precautions have been taken.
32 C. There are a few accident risks in my work.
D. Adequate safeguards eliminate accident hazards.
42 E. There are no important accident hazards connected with my job.
69 % not bad
5. As to your personal work abilities, how do you feel:
10 A. I have a great deal more ability than my job demands of me.
6 B. My job fails to use some of my strong work abilities.
15 C. Although I have other abilities my job requires careful exercise of certain abilities which I possess.
36 D. My abilities are well adapted to the requirements of my job.
33 E. I feel that my present experience is leading me to a larger and more interesting field of work.
6. For the most part, fellow employees in my department are:
1 A. Unfriendly.
1 B. Indifferent to me.
21 C. All right
19 D. Cooperative
58 E. Very friendly.
72 % fine
7. How do you feel about the opportunities for advancement ahead of you:
10 A. The outlook seems bad.
18 B. There may be such opportunity, but I doubt it.
17 C. I'm satisfied and don't particularly care about greater responsibility.
40 D. I believe my chance will come.
15 E. I know what I want next and believe I'm going to get it.

Figure 3. One of the inside pages of management's report to employes. See also Figure 2.

Such committees are advisory only, but they serve as excellent liaison between management and employes in getting something accomplished as the result of an attitude survey.

The opinion ballot is an audit of human assets which holds great promise for the future of employer-employe relations. A few companies have instituted it as a periodic feature, so to measure management effectiveness in handling its personnel. Thus the ballot takes its place in industrial democracy.

* * *

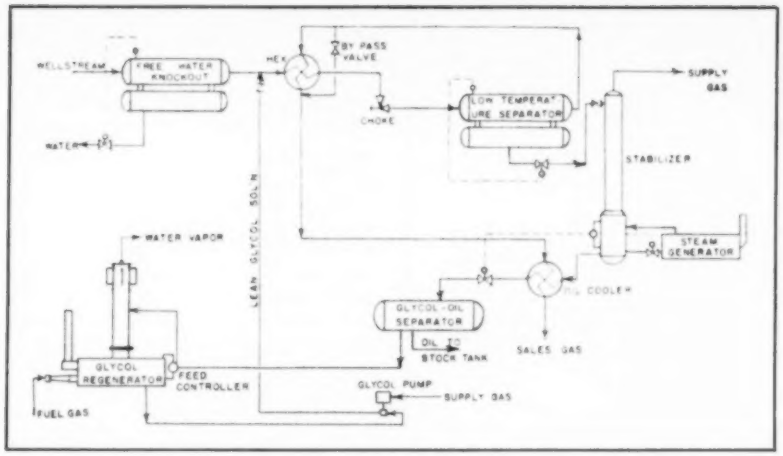

Figure 1. Typical flow sheet of a glycol injection system with a 125-psig W.P. stabilizer.

Dehydration of Natural Gas And Light Hydrocarbon Liquids

Part V. Taking advantage of hydrate inhibitors with expansion refrigeration.

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Oklahoma City

THE USE of a hydrate inhibitor in conjunction with expansion refrigeration minimizes the chief limitations of that system—namely, the hydrate temperature when cooling prior to the choke and the necessity of melting the hydrates formed.

Without an inhibitor the temperature at the coldest point in the system is fixed by the expansion temperature drop and this hydrate point. The necessity for providing means of melting hydrates not only requires an expensive type of construction but brings up other process problems. In view of these facts and as a result of several years observation, it has become obvious that the use of hydrate inhibitors in conjunction with low temperature units possesses certain advantages.

Once this fact was established it became necessary to determine which inhibitor offered the most promise in this service. The choice was at least narrowed by experience gained in previous pipe line practice. Ammonia, although it is an effective anti-freeze agent, reacts with any carbon dioxide present in natural gas to form a solid carbonate that lowers efficiency and plugs lines. Calcium chloride, and other chlorides, are also applicable but corrosion then becomes a problem. By a process of elimination the alcohols, particularly methanol, have been used as hydrate inhibitors in most pipe line and gathering systems. Of these methanol has been used chiefly since it is cheaper and effective as an inhibiting agent.

On the basis of wide experience with the glycols in dehydrators it was obvious that at least one member of this family also showed promise. Consequently the logical choice narrowed to the use of methanol and glycol as the hydrate inhibitor. Therefore, the discussion here will limit itself to a consideration of these materials.

Comparison of Methanol and Glycol

The relative merits of diethylene glycol and methanol are summarized in Table 1. Since methanol is substantially a vapor at normal line temperature, whereas the glycols are not, the former exhibits some advantage when uesd in pipe line service. The vapor can have little effect on pipe line efficiency and is more effective in melting hydrates already formed. However, the effect of small amounts of glycol liquid in pipe lines from existing plants has not been detrimental and preliminary laboratory investigations,[2] indicate that the liquid coats the pipe wall and should not lower the pipe line efficiency, unless injected in excess quantity. In low temperature service, however, the necessary qualifications differ from those in the pipe line. The piping is short and much lower temperatures are present in the system. Consequently, the accent is more recoverability, dew point depression and other such factors rather than pipe line efficiency, etc.

Methanol has an apparent advantage by virtue of its much lower initial cost but this is more than offset by the fact that its recovery is not economical. Therefore with the higher injection rate necessary, together with this total loss, methanol injection becomes the more expensive system. Because both methanol and glycol will "work" the widespread choice of glycol has been made primarily on economic grounds. (See Table 2.) The data on methanol in Table 2 have been obtained from the pioneer work of Hammerschmidt[1] while that for diethylene glycol is based on field data to date.

Comparison of the Glycols

All of the glycol injection systems now in operation use diethylene glycol as the desiccant. This choice has been made primarily on economic grounds since all the glycols are effective inhibitors.

The loss of glycol from the system is small but glycol is an expensive fluid so that careful attention to con-

TABLE 1

Comparison of Methanol and Diethylene Glycol Solutions As Hydrate Inhibitors in Low Temperature Systems

Assumed Conditions	
Tubing Flowing Pressure	1775 psig
Sales Line Pressure	775 psig
Tubing Flowing Temperature	110 F.
Condensate: 30 Bbl./Mmcf @ 775 psia and	10 F.
Low Temperature Separator Temperature	10 F.

Since only 1000-psig differential is available across the choke the gas must be cooled below its hydrate point before expansion. In order to do this something must be added to prevent hydrate formation at that point.

Below is compared the cost of using diethylene glycol and methanol as the hydrate inhibitor.

Basis: 1 Mmcf of natural gas

	Methanol Injection System	Glycol Injection Using Diethylene Glycol
Gallons needed in liquid to prevent freezing in low temperature separator	5.3	5.4
Gallons lost in the gas	4.4 gallon	less than 0.1 gallon
Total gallons to be added per Mmcf	9.7	5.5
Amount recovered	0.00	5.1*
Net amount used	9.7 gal./Mmcf	0.4 gal./Mmcf
Cost per gallon	$0.35	$2.25
Cost of regeneration		$0.20/Mmcf
Net cost per Mmcf	$3.39/Mm	$1.10/Mm

* Diethylene glycol is slightly soluble in condensate to the extent of about 1 gallon per 100 barrels. In this case then about 0.3 gallon is lost by this means.

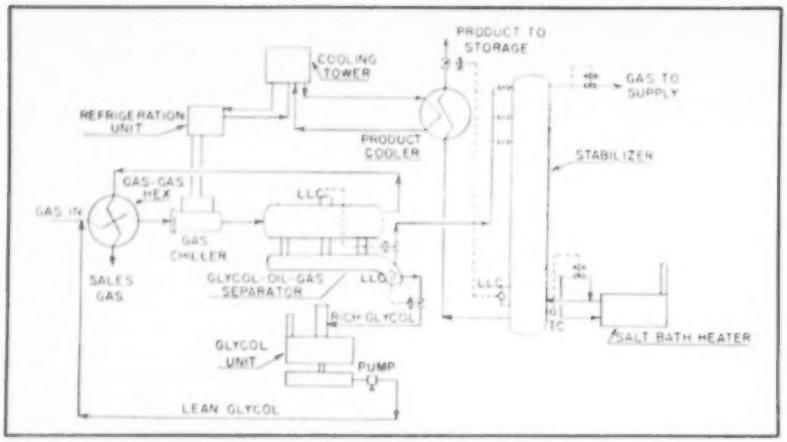

Figure 2. Typical flow sheet for a mechanical refrigeration system with stabilizer.

sumption is an important consideration. Glycol is lost by two means, its slight solubility in liquid hydrocarbons and vaporization. The latter loss is proportional to the vapor pressure which in turn decreases with increase in molecular weight. The solubility loss on the other hand is a function of two factors, the molecular weight and the concentration of glycol in its water solution. The solubility increases with molecular weight and the concentration of glycol in its water solution which is just opposite the effect on vaporization losses. With these factors in mind diethylene glycol is a very satisfactory compromise choice at this time based on present costs.

The flow diagram for a glycol injection system is very similar to that for other low temperature systems, as shown in Figure 1. However, some modifications are necessary to take full advantage of the inhibitor.

The inlet wellstream enters the knockout with or without prior cooling. Just downstream from this knockout, prior to the heat exchanger, the optimum amount of glycol is injected. This glycol then flows through the heat exchanger, across the choke into the separator with the wellstream gas. There it is separated with the condensate.

The cold sales gas then proceeds to either the wellstream heat exchanger and/or the stabilizer product cooler before entering the sales line.

The method of separating the glycol from the condensate varies somewhat with the method of handling the latter. However, the system shown in Figure 1 is typical for wellhead units with a low pressure stabilizer.

After being separated the glycol is reconcentrated in a unit very similar to that used for absorption dehydration and reinjected into the line.

A modification of the system described above has been successfully used in those cases where insufficient pressure drop is available to produce the desired refrigeration by expansion. A typical flow sheet for this system is shown in Figure 2. The process factors are the same except for the source of refrigeration.

The use of mechanical refrigeration is not advisable for dehydration unless the liquid recovery warrants it. The dehydration accomplished, however, plays an important role in comparing costs with an oil absorption plant where other dehydration facilities are necessary.

TABLE 2
Comparisons of Economics Between Different Separation Systems

SPECIFICATIONS ON LEASE STUDIED

Flow Rate	4 Mmcfd
Wellhead Flowing Pressure	2200 psig
Sales Line Pressure	900 psig
Wellhead Flowing Temperature	95 F.

	LTS with Two Stage Separation	LTS with Stabilizer	Glycol Injection with Two Stage Separation	Glycol Injection with Stabilizer
Temperature of Low Temperature Separator	25 F.	25 F.	0 F.	0 F.
Stable Stock Tank Recovery Barrels/Day	124	148	136	156
Additional Recovery Over LTS with Stage Separation Barrel/Day		24	12	32
Initial Cost of Equipment	$9,700.	$15,500.	$9,900.	$13,500.
Total Gross Payout Time—Days*	28.4	38.1	26.5	31.5
Gross profit on unit at the end of one year (365 day operation) after payout	$115,000.	$133,000.	$127,000.	$139,000.

* Based on a gross price of stabilized condensate of $2.75 per barrel.

Process and Equipment Factors

Wellhead Flowing Temperature and Pressure—When freezing is a danger in the gathering system of a central type plant the knockouts may be placed at the individual wellheads and glycol injected at that point. If this is done the glycol is recovered in the usual manner at the plant. With this arrangement glycol injection is often unnecessary, however, unless the gathering lines are long or are subjected to rapid cooling as with certain offshore locations. The efficient removal of water from the flow line effectively lowers the temperature at which troublesome amounts of hydrates will form. It has been found satisfactory for example, to install only the knockout originally and simply add glycol injection at that point if trouble is encountered. In many cases gas 10-20 F. below the theoretical hydrate temperature has been successfully carried, in the absence of substantial quantities of liquid water.

A heater may be used to prevent freezing in such a gathering system but the use of the inhibitor is cheaper and more convenient since regeneration facilities are available at the plant.

Handling of Fluids Prior to Choice—The methods for this system are the same as those in Part IV. In cases where water knockouts are used at the wellheads but there are large amounts of condensate an additional inlet separator or knockout at the plant is often advisable. By this means these liquids may be bypassed around the choke to increase the temperature drop.

Heat Exchange Requirements—In certain cases where the gas flowing temperature is exceptionally high it is advantageous to cool it prior to using a knockout. This offers several advantages:

1) Less inhibitor is necessary.
2) Lower separator temperatures are possible, giving more condensate recovery and greater dehydration.
3) The glycol regeneration load is reduced.

On the debit it is usually necessary to have cooling water or fan coolers to accomplish this because the cold sales gas cooling potential is largely used up in the heat exchanger just prior to the choke and the stabilizer product cooler. Fortunately the absolute need for pre-knockout cooling is the exception rather than the rule.

In order to take full advantage of the inhibitor and cool the gas below its hydrate point, more heat exchange surface following the knockout and

prior to the choke is often necessary than with other low temperature systems. As the pressure drop declines, for example, more cooling is required to replace that lost by expansion. Therefore, the size is conditioned by the expected service of the unit.

With a given amount of temperature drop of the gas due to its expansion the heat exchanger has a multiplying effect on lowering the separator temperature. As the gas temperature prior to the choke is lowered the sales gas is cooler which in turn further decreases the wellstream gas temperature to the choke. This dual-cooling continues until equilibrium is attained. The ultimate temperature possible may be calculated by means of a heat balance with due consideration for the degree of approach, which is largely a function of exchanger design and area.

The net result of lowering the heat exchanger exit temperature therefore provides a correspondingly greater reduction in separator temperature thus emphasizing the advantage that a hydrate inhibitor provides.

If the pressure decreases from that for which the unit was designed the effective Δt decreases and eventually the heat transfer area available becomes the limiting factor. For this reason it has been found advisable to include surplus heat exchanger surface on standard units to provide for this contingency.

A comparison of the performance of the low temperature separator with and without the inhibitor, with the same heat exchanger, is shown in Figure 3. The apparent dew point depression shown for regular low temperature units is in accordance with the discussion on that topic in Part IV (PETROLEUM REFINER, January, 1953). The dew point for glycol injection is based on an average depression of 25 F. below separator temperature.

Low Temperature Liquid Separation—Inasmuch as no hydrates are allowed to form conventional separators may be used for separation of the condensate, glycol and water from the gas at low temperature. The horizontal type is particularly applicable for this service.

The liquid settles into two virtually immiscible phases, one containing glycol-water and the other condensate. As mentioned above the glycol-water phase is slightly soluble in condensate to about 0.04 percent by weight.[4,5] For the average condensate this is about one gallon of glycol solution per 100 barrels. The necessary separation of these phases may be accomplished in several ways:

1) In the high pressure-low temperature separator by use of an interphase controller, the condensate going to stage separation or a stabilizer and the glycol to the reconcentration system.
2) In a low-pressure glycol-oil-gas separator (less than 50 psig) after running the total stream through a stabilizer or heater.

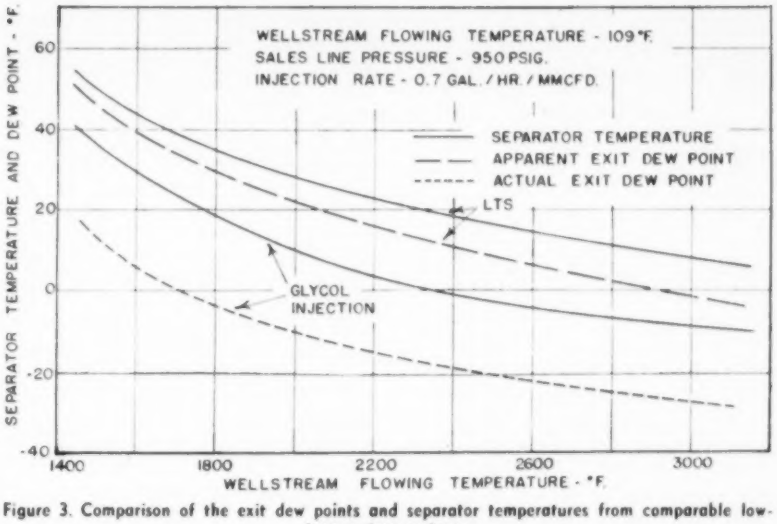

Figure 3. Comparison of the exit dew points and separator temperatures from comparable low-temperature systems.

Method 1 has particular merit when handling large quantities of liquid. The expansion of the three components across a valve tends to cause foaming and the presence of water and glycol reduce the efficiency of a stabilizer somewhat. For the average wellhead unit though these factors are not critical.

Regardless of whether a stabilizer is used or not the low temperature fluid should be heated before going to the stock tank. This operation will not only break up any emulsion formed but prevent excess weathering losses. The expansion of the condensate to lower pressure reduces its temperature even further and substantial quantities of methane and ethane are still held in the liquid.

In the absence of a stabilizer some heating is recommended between the high and low pressure separators. In order to prevent excessive loss of the stable components, however, the temperature of the liquid leaving should not exceed 70 F. The optimum temperature is best determined by test because it will vary with the composition of the liquid.

TABLE 3

Advantages and Disadvantages of Using a Hydrate Inhibitor in Low Temperature Systems

Advantages:

1. Greater condensate recovery and more dehydration may be accomplished with the same flowing conditions
2. Additional dehydration is obtained over and above that by refrigeration.
3. No hydrates are formed which decreases the operating problems.
4. Standard oil field equipment is used for the most part and gives a high salvage value.
5. A cheaper lower pressure stabilizer may be efficiently used.

Disadvantages:

1. The direct operating cost is slightly higher than for comparative low temperature systems.
2. The unit is not quite as compact and needs more equipment to make it function.
3. Initial cost is slightly higher.

Stabilization—When handling these low temperature fluids stabilization is far more efficient than stage separation and is recommended in virtually all cases. By this means weathering is minimized in the stock tank without excessive flare gas losses from separation equipment. A comparison of stock tank analysis from stage separated and stabilized fluids shows a much closer "cut" with the latter.

With cold liquids the feed point may be at or near the top of the column, eliminating the need for external reflux. The cold feed produces internal reflux which furnishes rectification on the vapors rising from below. This is evidenced by the sharp temperature differential on the several plates immediately below the feed. Therefore even though the column is theoretically a stripper it exhibits many characteristics of a fractionator.

The limitation on this type of column is the amount of "flash" at the feed point, in the absence of external reflux. With liquids in the temperature range being discussed, however, this section is primarily a depropanizer. Although any "cut" by this means is necessarily rough it is satisfactory because it serves to reduce the heat load on the column with only small losses of potentially stable fluid.

Since the equilibrium concentration ratio, K, values increase with decreasing pressure lower column pressures tend to increase the flash loss. How-

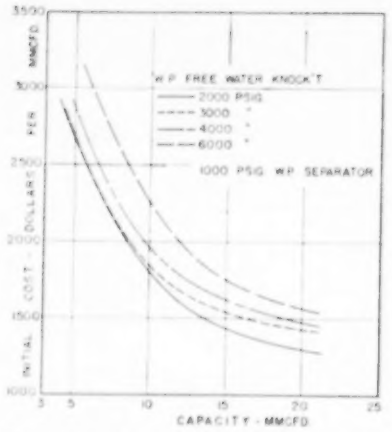

Figure 4. Initial cost estimation curves for glycol injection systems, including stabilizer.

ever, this is partly offset by a lower feed temperature due to increased expansion cooling of the liquid. Consequently the choice of column pressure is not contingent on this factor alone.

A 500-psig working pressure column is preferred in the following cases:

1) Where the amount of gas going overhead may be economically recompressed into the sales line.
2) Where specification natural gasoline and/or LPG is desired.
3) In large central plants where the higher initial cost may be justified by the slightly greater efficiency and flexibility.

Economics often dictate the use of a low pressure 125-psig working pressure column where only stable condensate is being produced. In many instances the recovery is comparable and this together with decreased height makes it very suitable for lease operation.

If an LPG product is desired two columns are indicated. The first may be a cold feed de-ethanizer operating at 400-450 psig and the second a conventional stabilizer with external reflux at 150-250 psig. A stripper, following the stabilizer may then be needed to produce specification natural gasoline. Field tests have shown such de-ethanizers to give comparative performance with other types.

Dew Point Factors

The exit dew point from a glycol injection system depends not only on the temperature of the low temperature separator but the amount of glycol injected. Only 0.2 to 0.4 gallons per hour per Mmcfd are required to prevent the system from freezing. Excess, however, is usually injected to obtain additional dehydration benefits. The injection of 1.0-1.5 gallons per hour per Mmcfd will usually give a dew point depression about 30 F. less than the separator temperature. This is based on using a 70-85 percent by weight glycol solution which has a low solubility in condensate and affords a maximum freezing point depression.

For this service the glycol reboiler should be operated at about 250 F., at which temperature the internal reflux triethylene glycol type reboiler and still column may be used. Glycol losses from the still column are negligible.

The maximum dew point depression that can be obtained across a choke is limited by the contact possible. From field data and computations a 30 F. depression could be relied upon with a pressure differential as little as 400 psig. By providing some additional contact in the line past data indicate that 40-50 F. depressions are not impractical since early triethylene glycol dehydrators utilized a pipe type contactor in the smaller sizes. This seems to be an effective upper limit, however, when it is considered that these latter units were using a highly concentrated solution as the absorption medium.

The comparison in Figure 3 is based on the depression obtained when using the same low temperature system, except for the addition of an inhibitor.

Economics

Inasmuch as a glycol injection system may be assembled with many different alternatives a correlation of the costs is difficult. In reality initial cost means very little unless the revenue is also considered. When this is done glycol injection has the lowest net cost of any type of dehydrator.

The initial cost of the type of unit shown in Figure 1, complete with a low pressure stabilizer, may be estimated from Figure 4. The prices shown are for a 1000-psig sales line pressure. For a sales line pressure of 500 psig or less, about $500 may be subtracted from the total unit cost while the same figure should be added for 1500-psig working pressure.

The approximate prices are for what might be considered standard units for the conditions shown. For unusual applications very rich gas, or where extra heat exchange is needed the prices shown will be slightly low. However, they may be used for estimation purposes in most instances.

For larger central plants up to 100 Mmcfd capacity other than those shown a price of $1400 per Mmcf is satisfactory. Above 100 Mmcfd capacity a price of $1250 per Mmcfd should be adequate. The prices shown are for equipment only since installation costs will vary with the location.

A comparison of Figure 4 with Figure 5 of Part IV (PETROLEUM REFINER, January, 1953) shows a much higher cost. However, the cost curves

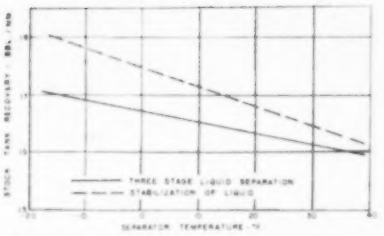

Figure 5. Comparison of stage separation and stabilization of low-temperature fluids.

for glycol injection include a stabilizer whereas the others do not. Without a stabilizer the glycol injection system usually costs about $1000 more than a comparable low temperature unit without injection. However, when comparing the two with a stabilizer the glycol injection system is $200-$3000 cheaper, depending on the size.

For a true comparison it is necessary to estimate the revenue by the various processing methods.[2,7] In the absence of a full wellstream gas analysis any estimation is very approximate. One "rule of thumb" that has been successfully applied is to assume that the recovery will increase 0.5-0.75 barrels per Mmcf for every 10 F. decrease in the separator temperature. For example, running the separator at 0 F. instead of 30 F. should increase the recovery at least 4-6 barrels per Mmcf. Like all "rules of thumb" such figures are subject to serious limitations. However, application to many situations has shown that it gives conservative results.

The operating costs including materials and utilities, but less labor varies from $0.60-1.30 per Mmcf. The cost for labor will vary with the location and the company accounting system. The labor charge does not usually exceed 2-3 man hours per day except in very large plants.

Tabulation of all these variables will give reasonable figures for amortizing the plant and charging overhead. In most cases such tabulation will show that use of a glycol injection type low temperature system gives the best ultimate payout. The cost, if any, chargeable to dehydration is therefore very low.

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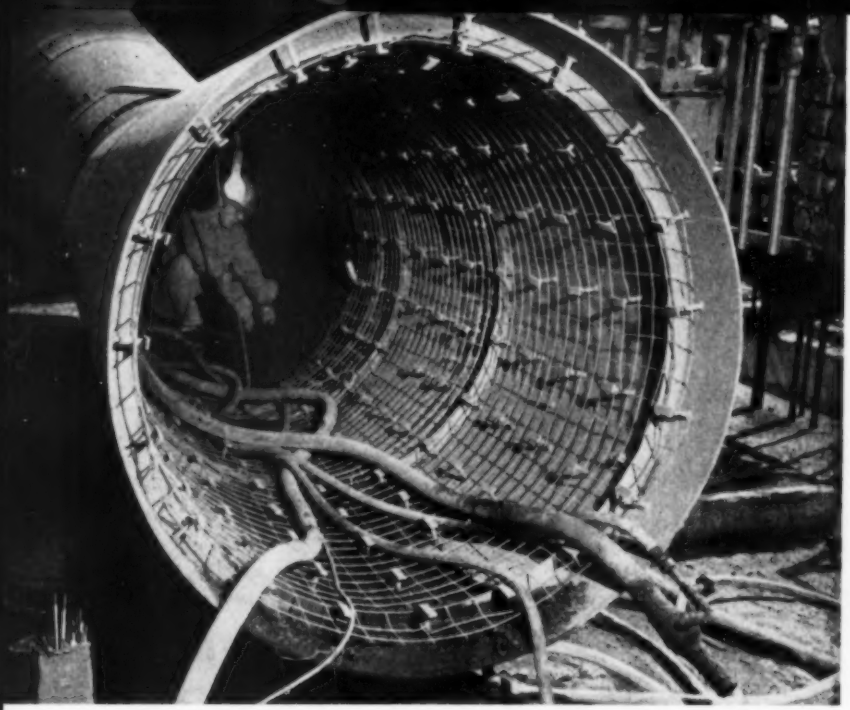


No horn of plenty, but one through which plenty of oil and catalyst will flow. Insulating lines on the inside greatly reduce erosion, keeps unit in operation longer.

Cat Cracking Capacity Increased by Unusual Methods

Humble Oil & Refining Company expands cat crackers by systematic program of bottleneck removal and redesign.

THIS IS A success story—of the expansion of two cat crackers from a design capacity of 30,000 barrels a day to the present charge rate of 110,000 barrels a day.

How was such an enormous increase achieved? The answer to that question makes an absorbing story.

It is a story of sound engineering, of cooperation and skill by mechanical crafts, of research that paid off, of process men who could meet new challenges, and of an aggressive management willing to take calculated risks. The scene is Humble Oil & Refining Company's Baytown, Texas, refinery. The time is the last ten years.

Smashing the Bottlenecks

No sooner had the first cat cracker gone into production ten years ago than men began to search for ways to increase its capacity. Was a pump too small for its job? They studied the possibility of taking it out, using it elsewhere, and replacing it with one or more larger ones. This same searching scrutiny was applied to each component part of the equipment.

The detailed study paid off. Here and there, a revision or rearrangement of piping made possible a few more barrels of feed. Air lines were enlarged to move greater quantities of catalysts. Heat exchangers were rearranged to increase furnace coil inlet temperatures.

As a result of these studies, enough bottlenecks were removed between 1943 and 1948 to increase the capacity of No. 1 cat unit by more than 100 percent. After such encouraging results, the work was continued.

Safer and Better

Next, in 1950, a thorough study was instituted of those heat exchangers responsible for heat removal from the catalyst.

It was decided that the exchangers did not meet the company's standards for safety. They had caused no fires or accidents, but trouble with them had led to an occasional downtime of the unit. In the interest of better operation and safety, the debated exchangers were removed. Necessary changes were made to supply supplementary heat. The net result was an increase in capacity of another 7000 barrels a day. Thus was brought about not only a safer operation but a better one.

Bigger and Better Cyclones

An integral part of any fluid cat cracking unit is the system of cyclones used to disengage catalyst from oil vapors.

The old style cyclones were designed for fairly low rates and velocities. Under the conditions of the higher feed rates, erosion of the cyclones became a serious problem. As erosion progressed, efficiency fell off. It became necessary to remove the units from operation fairly regularly to replace the eroded cyclones.

The next logical step was to replace the outmoded cyclones with newer and better models. Research and development had led to the design of cyclones that could handle higher velocity flows and larger volumes of oil vapor—catalyst mixture. The newer cyclones provided for the use of erosion resistant materials, a feature lacking in the old models.

The changeover from old to new cyclones made possible an additional 6000 barrels a day of feed rate. The unit was now up to a charge rate of 40,000 barrels a day, a considerable improvement over the initial design of 13,400.

Still More Capacity

Perseverance and enthusiasm stimulated a study designed to reach the ultimate in capacity. A complete engineering survey was started on both cat units. Every detail of equipment was studied critically. Each item from the largest vessel to the smallest pump and flow line was given a thorough engineering check, followed by a recheck, to determine limitations and ways to remove them. Special emphasis was placed on possible modification of auxiliary equipment—such as pumps, furnaces, gas compressors, and air blowers.

Instrumentation was examined critically in an effort to determine the optimum arrangement for smooth production.

The study led to some major

changes. An additional furnace was added, a large centrifugal gas compressor was added, new pumping capacity was supplied, and a great many of the flow lines were enlarged. Here, for the first time in the continuous program of expansion, costs ran into big money. But the dividends were equally large. By virtue of the changes, No. 1 cat unit's capacity was pushed up another 15,000 barrels a day, to a new high of 55,000 barrels.

Trouble Arises

One sidelight of the expansion program at No. 1 cat unit had interesting ramifications. When the unit was brought down for routine turnaround in 1952, one major item of expense was replacing a large vessel, the catalyst stripper. Engineers and inspectors made a disturbing discovery. Just across the unit from the stripper, inspectors found that a large reactor with related smaller vessels was bulged and cracked. It was estimated that no more than six months or one year of safe operation remained for the equipment. Here was a dilemma—and some hard choices had to be made. Either the unit could go back on stream after this downtime with the doubtful equipment, and then be shut down soon for another long turnaround, or a way must be found to fabricate a substitute vessel to be installed during the current downtime.

A completely new vessel, made to order and delivered to the job site in time, was out of the question. To order the steel, have it rolled and shaped, and welded into the required vessel would take perhaps a year. The alternate possibility was to find the steel close at home and do a homemade job.

An immediate search of nearby sources failed to produce the steel.

The vital material was found in the refinery's own back yard. Three, 20-year-old, riveted vessels were located in the scrap pile. A thorough inspection revealed that they were structurally sound and the right diameter—20 feet—so major rerolling would not be required.

Fast Work Pays Off

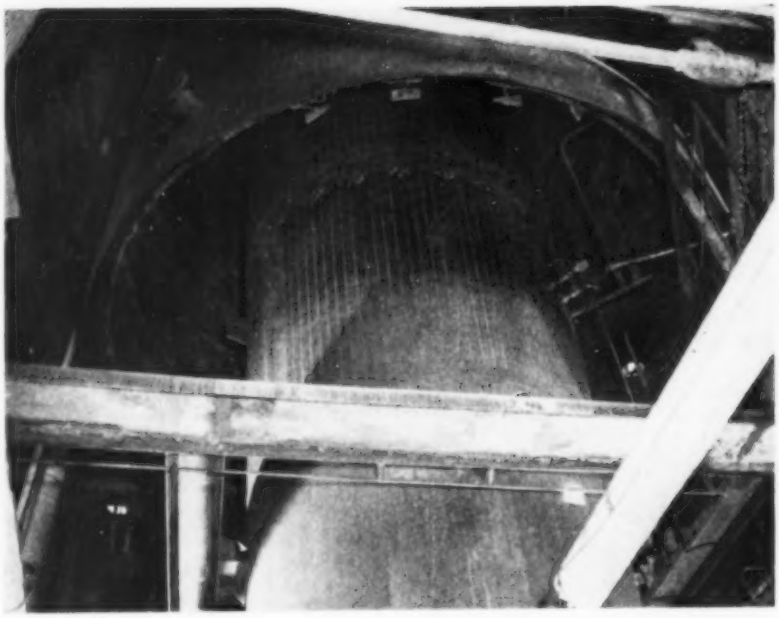
With the steel located, a corps of engineers was put on the job. The problem was to remove a sufficient number of correctly sized, curved plates from the salvaged vessels, and fit them together again into a welded vessel of precisely the right proportions. The engineering brain teaser was successfully solved and the new vessel installed.

Research Develops New Technique

While engineering work progressed on those changes described above, research men busied themselves with their pilot unit. A radical new departure in catalytic cracking technique was developed. The conventional fluid catalytic cracking reaction takes place in large wide vessels; and the mixture of catalyst and oil swirls rather slowly through them. In the new technique the reaction takes place in a narrower space with catalyst and oil vapor moving at higher velocities.

The new theories were put to test in a small reactor—a pipe just an inch in diameter. Test results were excellent. The new design was dubbed "transfer line reactor."

Further experimental work was car-



Transfer line reactor was a product of Baytown Refinery research. To save time, trouble and money, it was thrust right up through the shell of the old reactor.

Erosive action of catalyst knifed away these cyclones, or tubes in which catalyst becomes separated from the oil.

New-type cyclones are larger, handle higher velocity flow, resist erosion better and add to the capacity of the two cats.

ried out in the "kitty cracker," a pilot unit replica of the plant unit.

New Design Installed

The transfer line reactor for the No. 1 cat cracker was designed from the operating data obtained on the pilot unit. The new reactor was installed in September, 1952, and was an immediate success. While preliminary test work is still being carried on, sufficient data have been obtained to prove the success of the new design.

The major changes to No. 1 cat unit included the radically new reactor, a new catalyst stripper, a homemade regenerated catalyst hopper, and scores of minor changes. The revised unit bore little resemblance to its old self.

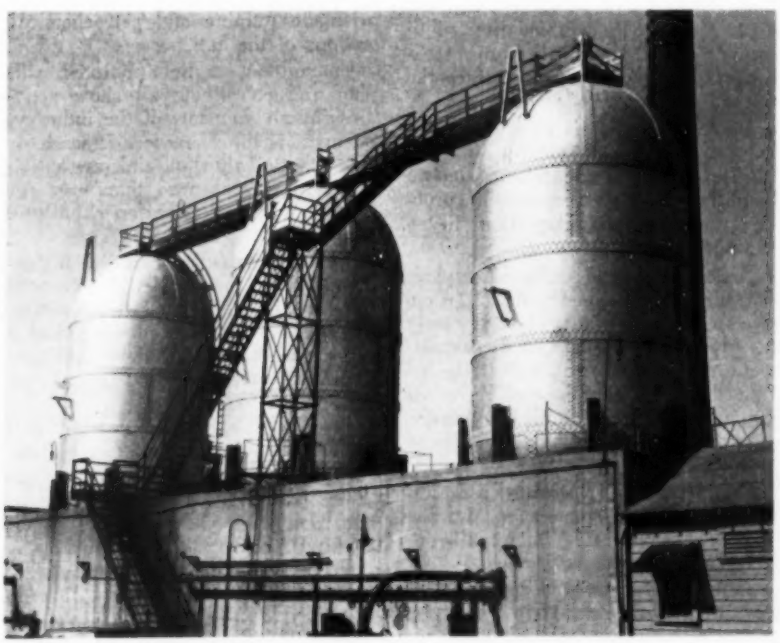
This brought another problem—that of training men to cope with the operation of the new unit. The training job began early. Process crews were brought back on the job (they had worked elsewhere in the refinery during the downtime) and indoctrinated with the changes. Actual classroom studies were held on the job—to trace new flow systems, study new heating problems, and acquaint all operators with the location and use of new equipment.

The early start in classroom work paid off handsomely. It was somewhat more difficult for the process men to operate the unit at the increased rates. For one thing there was more equipment to handle. Control instruments, especially, had to do precisely what they were supposed to do—or the unit did not operate properly. As a result of the intensive training, the transition was made smoothly.

Expansion at Cat Unit No. 2

Few of the changes made to increase No. 2 cat cracker's capacity were quite as radical as those made at its companion unit. Through the same pattern of study and change and modification, No. 2's capacity was pushed upward in about the same proportion as No. 1.

Removal of bottlenecks by changing and substituting equipment between 1944 and 1948 increased capacity from 16,000 to 38,000 barrels a day. Modern cyclones added another 1000 barrels. Detailed engineering study brought on the biggest increase—an extra 16,000 barrels a day up to a daily total of 55,000 barrels.



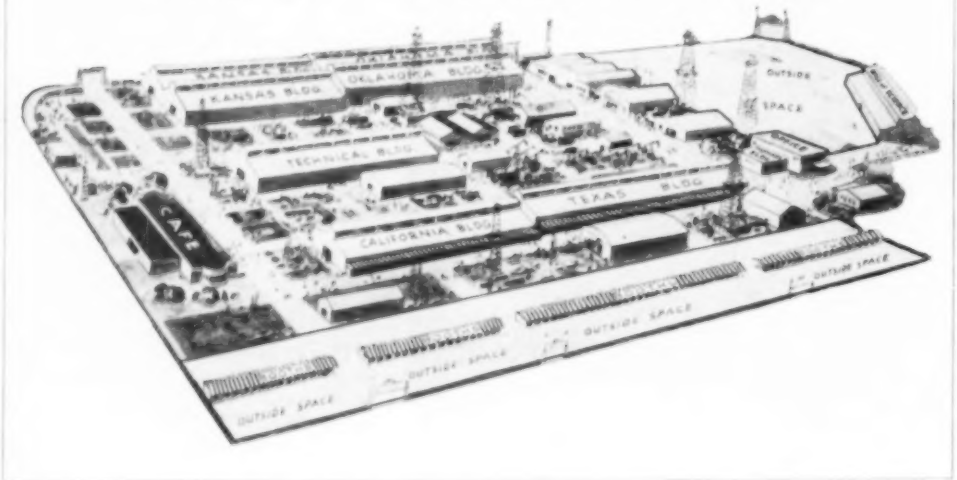
These old tanks furnished steel when a vital part of No. 1 Cat broke down and had to be replaced in a hurry.

The Climax of a Success Story

This was the climax of an unusual success story. Two units, designed for a total capacity of about 30,000 barrels a day, now process a total of 110,000 barrels a day. Of course, the increase in capacity at these two units brought about necessary revisions in the equipment handling feed stock and products for the cat units. A new deasphalting plant is under construction to provide additional feed. Ground has been broken for a new light ends recovery distillation unit to process the additional catalytic light ends.

Thus it is that a major expansion of a key process like catalytic cracking makes itself felt all over the refinery. So profound is its influence on other processes that expansion in one direction must be followed by expansion in others.

Large exhibit areas have been added to the IPE grounds at Tulsa for the 1953 exposition scheduled May 14-23. Picture shows this "outside space" as well as the buildings.



Petroleum Industry Promises "Show of Shows"

THE REFINING division of the petroleum industry will be recognized at a special "Refiners' Day" during the 30th Anniversary International Petroleum Exposition next May 14-23 in Tulsa.

The tenth day of "The World's Fair of the Petroleum Industry," May 22, has been set aside to honor the men who process crude petroleum.

Refinery visitors to the exposition—from executives to stillmen—will be hosts for the oil show on "Refiners Day." In addition, a special committee will select and honor individuals who have made outstanding contributions to the progress and achievements of the refining industry, according to William B. Way, IPE general manager.

The 1953 exposition has been under preparation for nearly a year, and, though still months away, it is assured a record 1500 exhibits valued at approximately $100 million.

This year's show "will be keyed to present the many new methods and improvements in all phases of the industry" with 310 exhibits directed to refining alone. These will feature techniques developed primarily since the last oil show in 1948.

In addition to this record total of commercial refining exhibits, the exposition Hall of Science will contain displays of the latest equipment, processes and scientific adaptations in refining.

Scale models and animated displays of refining techniques will fill an entire section of the hall, which is purely an educational adjunct of the exposition. Science hall exhibits will be arranged by the Scientific and Technical committee, headed by G. H. Westby, president, Seismograph Service Corporation, Tulsa.

W. J. Carthaus, Deep Rock Oil Corporation, Tulsa, is chairman of a Refining subcommittee which will display refining exhibits in the hall.

Petrochemistry will occupy a place of prominence in the Hall of Science, a special subcommittee being in charge.

Dr. Miller Conn, manager of market development, Phillips Petroleum Company, is chairman of this subcommittee which includes Dr. Isaac Drogin, research director, United Carbon Company, Charleston, W. Va.; Leroy Donald, sales manager, Chemical Sales division, Lion Oil Company, El Dorado, Ark.; James G. Park, vice president, Enjay Company, New York, and Merton H. Keel, Shell Chemical Company, New York. "Some of the most important developments in petrochemistry have come about since the 1948 oil exposition, and these we hope to feature," Dr. Conn said. "Displays and working models will enable visitors to see and understand methods of extraction and application of petroleum chemicals which only five years ago were in experimental stages."

There is no charge for exhibits in the Hall of Science. Research, laboratory, mechanical and technical displays contributed by refining companies, chemical firms, refinery equipment manufacturers, and private scientific and research institutions will comprise the refining and petrochemical sections of the hall.

Committees, to be appointed, will plan and coordinate oil show activities for all segments of the industry. So great is the increased demand for space that oil show officials are anticipating a greater need than ever for industry representatives on exposition committees and advisory groups.

International attendance is being encouraged by the NOMADS organization, the U. S. Department of State, the Department of Commerce, and a large number of "oil show ambassadors" appointed by exposition President W. G. Skelly.

Skelly predicts some 50 nations will be represented at the 1953 exposition. In 1948 there were 43 nations represented with visitors at the show. Foreign delegates will be guests of the NOMADS during the exposition.

Special housing arrangements are being made by the housing bureau which has been functioning for months. Through it, some 1150 Tulsa families have listed their homes for use by exposition visitors.

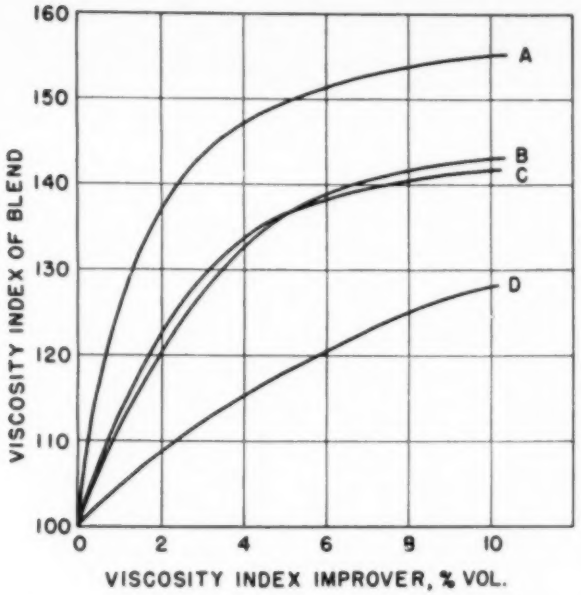


Figure 1. Viscosity index of lubricating oils containing viscosity index improvers. Viscosity of oil—40 seconds SSU @ 210 F.

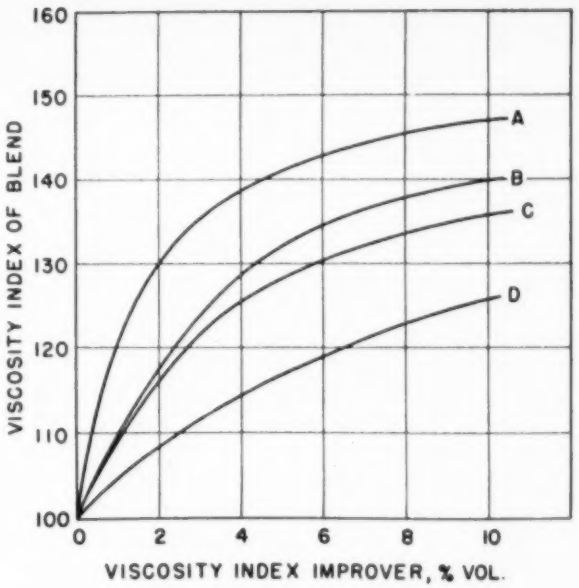


Figure 2. Viscosity index of lubricating oils containing viscosity index improvers. Viscosity of oil—42.5 seconds SSU @ 210 F.

Evaluating Viscosity Index Improvers

This method gives a relation useful for a particular improver and any *base* stock.

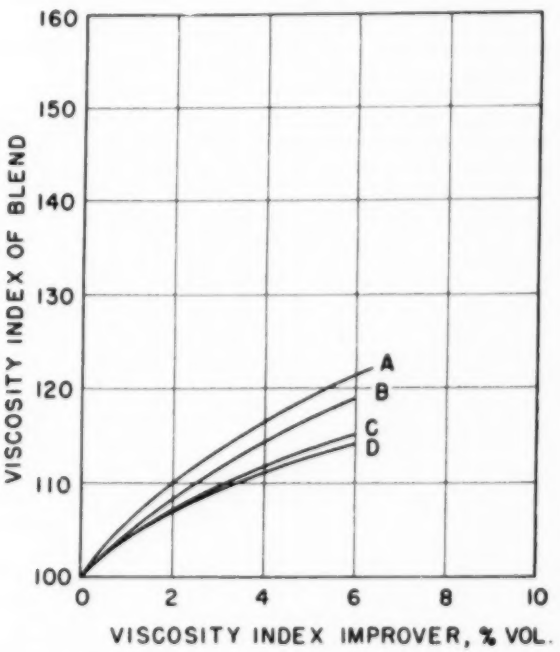


Figure 3. Viscosity index of lubricating oils containing viscosity index improvers. Viscosity of oil—60 seconds SSU @ 210 F.

E. J. Reeves
Magnolia Petroleum Company,
Beaumont, Texas

SOME HIGH viscosity index oils can only be efficiently prepared when employing additives. Determining the amount of additive, choosing the oil with greatest additive response and selecting the most effective additive is exceedingly difficult. In resolving these problems the viscosities of the blend are frequently obtained from the ASTM and other viscosity blending charts. However, because of the non-Newtonian nature of mixtures of lubricating oils none[1] of the relations are entirely satisfactory for accurately predicting viscosities. Without correct viscosities the viscosity index of these blends cannot be obtained. Many blends exhibit a maximum viscosity index (higher than either component) which usually occurs when a small amount of high viscosity oil (bright stock) is blended with a large quantity of low viscosity oil (neutral oil). Data showing this effect are presented in Table 1. The same phenomena takes places in blends with viscosity index improvers making the accurate prediction of viscosity

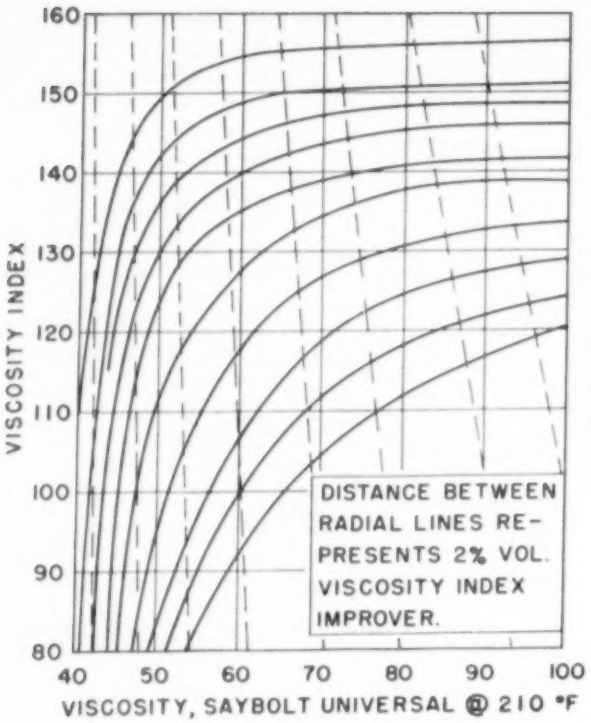


Figure 4. Viscosity index of lubricating oils containing viscosity index improver "A."

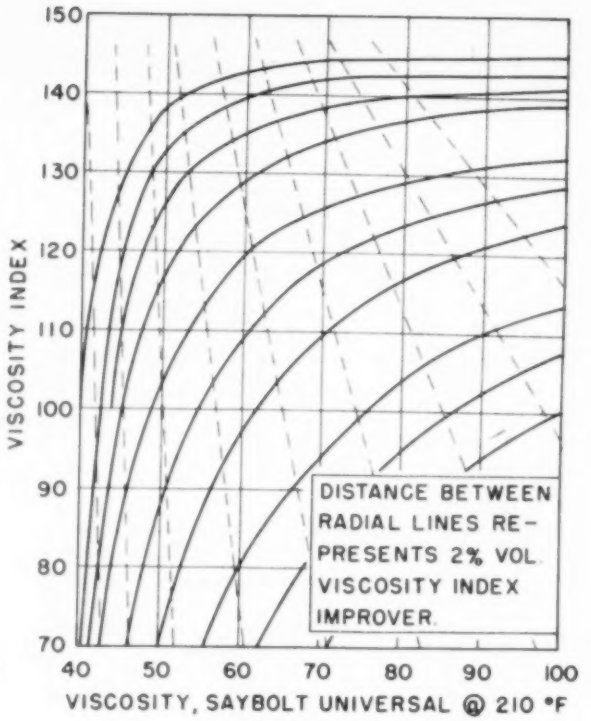


Figure 5. Viscosity index of lubricating oils containing viscosity index improver "B."

indexes even more difficult.

The viscosity index of oils containing additive may be estimated from the viscosity and viscosity index of the oil by a suitable blending graph. Most blending charts are limited in their use to the particular base stock and additives for which they are prepared; however, the method discussed[2] gives a relation useful for a particular viscosity index improver and any base stock, regardless of crude source. There is no apparent difference in additive response for various oils. Typical blend curves for four additives are shown in Figures 4, 5, 6 and 7. The distance between the dotted radical lines indicates the quantity of additive necessary to increase the viscosity index from one level to the next. The method for using the charts is outlined below.

Locate the point on the curved tie lines corresponding to the viscosity and viscosity index of the base lubricating oil. Follow the tie line upward to the desired viscosity index level. The viscosity at this point is that of the additive-lubricating oil blend. The amount of additive required is found from the number of radial lines crossed.

Charts such as these are easily prepared by blending various quantities of the additive with miscellaneous refinery lubricating oils. The tie lines shown in the figures are drawn from these data. In determining the position of the radial lines the base stock is assumed to be a mixture of an unknown oil and additive. With this assumption, there is no place on the graph for a zero additive content and the points representing the same quantity of additive are not necessarily connected. The radial lines are placed to represent equal increments of additive for any viscosity or viscosity index oil.

If the graph is carefully constructed and interpreted the deviation of the calculated viscosity index and viscosity from their true value will be small. Table 2 shows the differences between the calculated and true values for blends with viscosity index improver—"C." The average deviation is 0.9 and 1.1 for viscosity index and viscosity, respectively. The maximum viscosity index deviation was 3.0 and occurs in the region of low viscosity where this property is most difficult to determine. Maximum viscosity deviation was 7.0. These differences are typical of the errors found with other materials. Correction charts or tables[3] for the deviations can be made when greater accuracy is required.

TABLE 1

Maximum Viscosity Index of Oil Blend

Composition of Blend, Percent Volume		Viscosity of Blend, Saybolt Universal Sec.		
M/C Bright Stock	M/C Neutral	100 F.	210 F.	Viscosity Index*
0	100	125.3	42.0	115.1
5	95	137.4	43.0	115.4
10	90	151.0	44.2	117.5
15	85	163.0	45.2	117.7
20	80	176.4	46.3	118.1
40	60	265.1	52.1	112.3
60	40	404.6	61.0	110.2
80	20	605	72.1	106.0
85	15	659	75.4	106.5
90	10	759	80.5	104.9
95	5	848	85.0	104.1
100	0	937	89.6	103.6

* Calculated from viscosities in centistokes (Dean and Davis Tables).

Frequently the refiner must choose between several commercially available materials or determine the value of a new additive. The evaluation is made by assuming an oil with a suitable viscosity index and viscosity and then plotting the viscosity index of the blend versus the percent additive required to attain that viscosity index. Figure 1 shows the viscosity indexes secured by blending the various additives and an oil having a viscosity of 40 seconds SSU @ 210 F. and a viscosity index of 100. The data indicate that Additive A is the most effective while D is the least effective. Materials C and D appear to have equal value as viscosity index improvers. The comparison is valid only for the hypothetical oil used since at another viscosity the difference between B and C might be accentuated.

The effect of the same four viscosity index improvers when added to an oil with a viscosity of 42.5 seconds SSU @ 210 F. and a viscosity index of 100 is

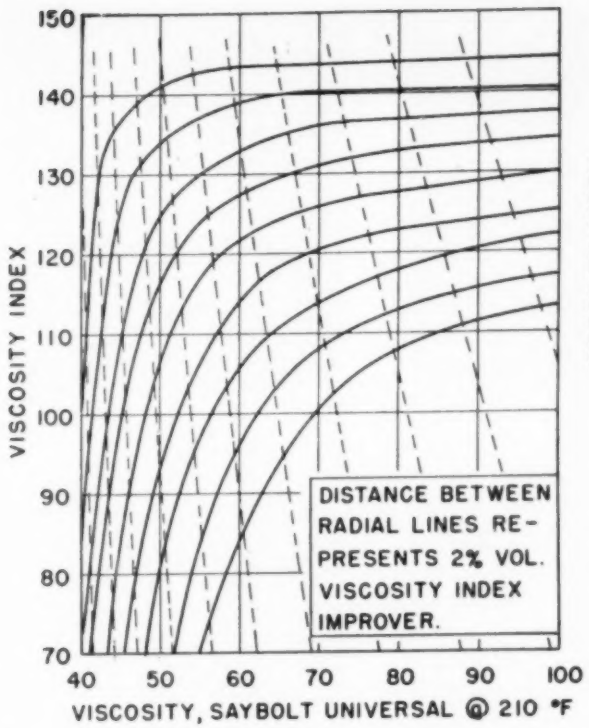

VISCOSITY INDEX
VISCOSITY, SAYBOLT UNIVERSAL @ 210 °F
DISTANCE BETWEEN RADIAL LINES REPRESENTS 2% VOL. VISCOSITY INDEX IMPROVER.

Figure 6. Viscosity index of lubricating oils containing viscosity index improver "C."

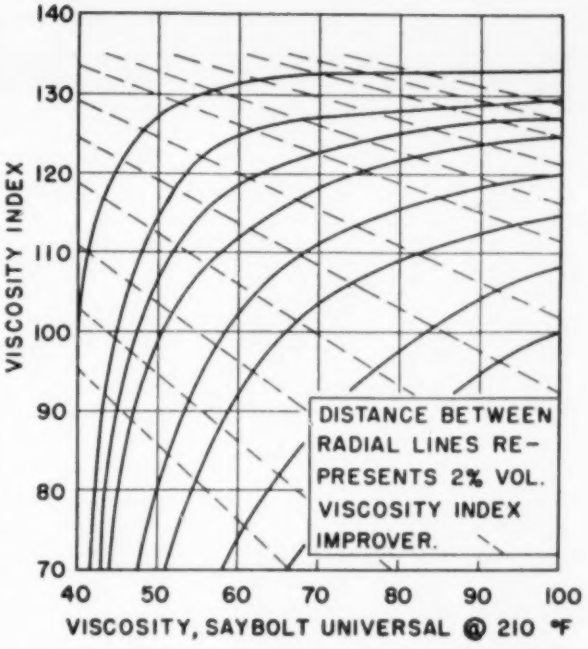

VISCOSITY INDEX
VISCOSITY, SAYBOLT UNIVERSAL @ 210 °F
DISTANCE BETWEEN RADIAL LINES REPRESENTS 2% VOL. VISCOSITY INDEX IMPROVER.

Figure 7. Viscosity index of lubricating oils containing viscosity index improver "D."

shown in Figure 2. The graph again shows that A is the most effective and D is the least effective. Additive B in this case appears more desirable than C. However, for quantities of additive below 2 percent volume, either B or C might be used.

The viscosity index improvers are used primarily in the low viscosity oils, SAE 10 and 20 but high viscosity index oils in the SAE 30 and 40 range are sometimes prepared. The additive which is satisfactory for the SAE 10 oils may not be the most effective in the higher viscosity range. This is illustrated by the curves presented in Figure 3. In this case the base oil has a viscosity of 60 seconds SSU @ 210 F. and a viscosity index of 100. Additives C and D in these blends are about equal; conversely, in the data shown above, C is always superior to D.

Summarizing, the viscosity indexes and viscosities can be predicted for blends of a particular viscosity index improver and any lubricating oil base stock, regardless of crude source. The special blending charts for this purpose must be prepared from data secured for actual blends of several different stocks with the additive to be investigated. Serious error will result if an attempt is made to determine the most effective viscosity index improver from a few isolated blends.

ACKNOWLEDGMENT

The writer would like to express his appreciation to Magnolia Petroleum Company for permission to publish this manuscript, which was originally presented as "Evaluation of Viscosity Index Improvers" at the Eighth Southwest regional meeting of the American Chemical Society, December 4, 1952, Little Rock, Ark.

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[2] Kalichevsky, V. A. and Savage, F. C., Oil Gas J. **43**, No. 27, 77 (1944).

[3] Kalichevsky, V. A., Pet. Refiner **28**, No. 7, 1925-8 (1949).

TABLE 2

Deviation of Predicted Viscosity Index and Viscosity From True Value for Oils Containing Viscosity Index—"C"

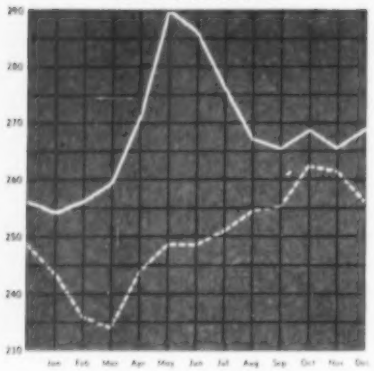
COMPOSITION OF OIL BLEND, PERCENT VOLUME AT							DEVIATION FROM TRUE VALUE Viscosity Index Improver—"C", Percent Volume					
M/C Neutral[1]						M/C Residual 134° SSU	Viscosity Index			Viscosity		
39.5° SSU	41.8° SSU	42.7° SSU	43.8° SSU	46.9° SSU	56.3° SSU		2	4	8	2	4	8
100	...	...	...	...	...	...	3.0	2.2	2.5	0.6	1.5	3.2
...	100	...	...	...	...	...	1.0	0.5	0.0	0.2	0.9	1.3
...	...	100	...	...	...	...	0.4	1.9	2.2	0.2	0.2	0.3
...	...	...	100	...	...	...	1.6	0.2	0.3	0.9	0.1	0.8
...	...	...	...	100	...	...	0.5	0.2	0.5	0.1	0.3	0.1
...	...	...	...	...	100	...	1.0	0.8	0.5	0.1	0.5	0.1
...	...	...	...	...	...	100	...	...	...	...	...	...
...	90	...	...	...	...	10	2.4	0.6	0.4	0.9	0.9	2.2
...	70	...	...	...	...	30	0.5	0.7	0.3	0.5	0.8	7.3
...	70	...	...	...	20	10	2.7	0.3	0.6	1.3	0.7	3.1
...	35	...	...	...	60	5	0.3	1.2	0.4	0.1	1.0	3.1
...	55	...	...	...	20	25	0.2	0.5	0.5	0.7	0.5	1.6
...	30	...	...	...	60	10	0.8	0.2	0.4	0.5	1.2	2.7
...	20	...	...	...	60	20	0.8	1.3	1.6	0.5	1.3	0.4
...	40	...	...	...	20	40	1.0	1.2	1.6	0.5	0.6	0.5

[1] Viscosity at 210 F.

* * *

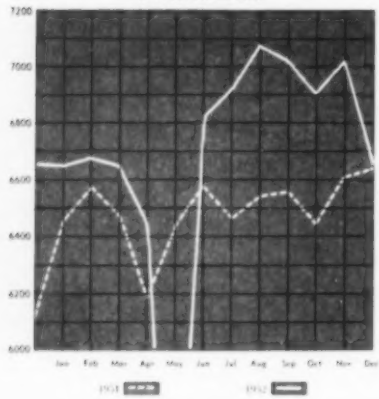
CRUDE STOCKS

Millions of Barrels End of Month



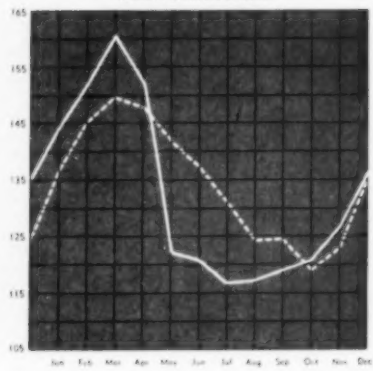
CRUDE RUNS TO STILLS

Thousands of Barrels Daily



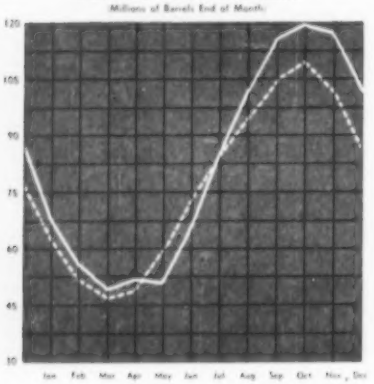
GASOLINE STOCKS

Millions of Barrels End of Month



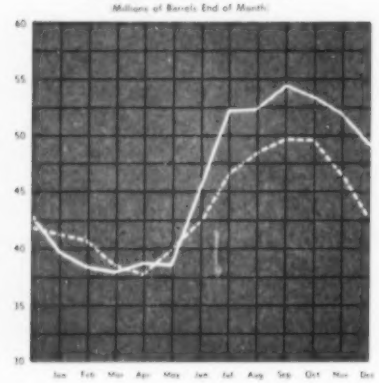
DISTILLATE FUEL STOCKS

Millions of Barrels End of Month



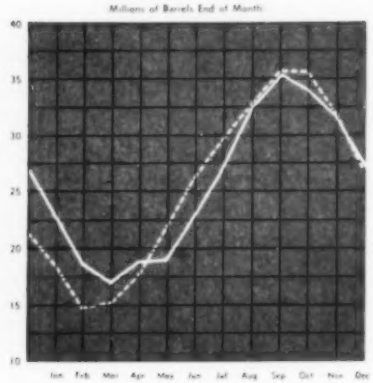
RESIDUAL FUEL STOCKS

Millions of Barrels End of Month



KEROSINE STOCKS

Millions of Barrels End of Month



Taking Stock

Cecil W. Smith

Economics Editor

(DATA IN THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		KEROSENE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1951:													
June	6,130	6,575	248,170	3,100	137,009	317	26,204	1,254	72,140	1,277	42,398	563	876
July	6,141	6,462	250,847	3,091	130,931	341	29,679	1,228	84,282	1,275	46,320	546	788
August	6,232	6,539	254,276	3,114	124,202	339	32,728	1,237	94,028	1,226	48,365	529	780
September	6,261	6,558	254,900	3,127	124,530	364	35,773	1,282	104,082	1,228	49,608	500	744
October	6,375	6,446	262,266	3,105	118,864	363	35,759	1,295	109,544	1,224	49,573	421	769
November	6,272	6,609	261,100	3,130	122,723	403	32,116	1,358	101,666	1,304	46,491	425	802
December	6,182	6,646	255,783	3,150	134,867	393	27,088	1,442	86,619	1,313	42,853	423	834
1952:													
January	6,217	6,640	254,007	3,094	144,339	421	22,679	1,456	66,969	1,338	39,523	488	951
February	6,367	6,673	255,900	3,109	151,912	370	18,530	1,528	55,369	1,322	38,295	491	940
March	6,388	6,640	259,126	3,089	160,689	386	16,817	1,400	48,750	1,274	37,971	510	947
April	6,429	6,435	270,679	2,995	151,890	366	18,955	1,312	51,634	1,253	38,561	539	922
May	5,107	4,905	280,813	2,295	123,656	229	19,614	982	51,648	979	38,821	545	951
June	6,197	6,825	285,964	3,109	120,166	317	23,061	1,455	65,911	1,228	45,688	581	901
July	6,083	6,927	275,951	3,295	116,566	358	27,387	1,475	85,775	1,237	52,245	597	892
August	6,219	7,118	264,368	3,377	118,592	375	32,401	1,514	104,257	1,252	54,061	632	879
September	6,518	7,017	264,723	3,428	120,991	350	35,021	1,502	117,252	1,230	56,200	615	902
October	6,518	6,883	269,776	3,301	120,062	352	33,289	1,458	120,721	1,203	53,052	643	1,038
November	6,633	7,031	265,885	3,404	127,210	392	32,040	1,531	117,472	1,248	52,152	637	1,022
December	6,558	6,677	268,465	3,377	135,906	423	27,490	1,514	101,843	1,282	49,117	580	1,085
Dec., 1951—Change:													
In Month	—75	—364	+2,580	—27	+8,696	+31	—4,550	—17	—15,629	+34	—3,035	—57	+63
In Year	+376	+21	+12,682	+227	+1,039	+30	+402	+72	+15,224	—31	+6,264	+157	+251
Week Ended:													
1-24-52	6,492	7,031	266,623	3,308	145,879	394	23,800	1,589	85,179	1,253	46,918	538	1,003
1-26-52	6,194	6,584	253,186	3,093	143,621	409	23,490	1,484	71,922	1,317	39,957	530	908

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[Meet Our Authors]

R. C. Teitsworth | Eugene J. Benge | Louis J. Murphy | Seymour Schwarz | M. Tarnpoll

Californian Has Real Outside Likes

Richard C. Teitsworth, "Improve Polyform Operations with These Correlations," page 91.

Since joining Magnolia Petroleum Company in 1949, Richard C. Teitsworth has accumulated much experience in light oils processing and in polymerization. He is now process engineer in charge of the company's Fort Worth, Texas, refinery and Polyform unit operations.

Prior to his association with Magnolia he was process engineer with General Petroleum Company, which he joined soon after receiving a B.E. degree in chemical engineering from Yale University in 1948. He had been graduated from California Institute of Technology in 1945 with a B.S. degree in mechanical engineering.

Heading the list of this native Californian's outside interests are music and the arts. But his list also includes two real "outside" interests: fishing (fly and surf) and golf.

Benge Applies Ruler To Employe Morale

It was in 1939 that Eugene J. Benge, author of "Measuring Employe Morale," appearing on page 128, founded his own company, Benge Associates, Hu-Management Engineers. This firm, which conducts aptitude tests and other fact-finding research, is concerned with "Hu-Management" problems.

Since that time, Benge, president of the company, has gained a wide reputation in the field of industrial relations, and demand for him as a lecturer has risen steadily. As a result of high interest in lecture tours he made under the sponsorship of Temple University, the University of Pennsylvania and Babson Institute, he established in 1943 his own clinics for sales and personnel managers.

Author of numerous guidance and text books, he last wrote for PETROLEUM REFINER in October, 1952. He holds a degree in public education and has also studied at the U. S. Army psychological training school. Prior to going into business for himself he was industrial relations manager for The Atlantic Refining Company and later for American Oil Company.

Murphy Goes A to Z On Compressor Systems

Compressed air systems are going to get a thorough going over before Louis J. Murphy is through. The author of "How to Select Compressors," which appears on page 115, has already tackled the problem of engineering refinery compressed air systems (PETROLEUM REFINER, December, 1952), and he has papers devoted to many other facets of this timely subject on tap.

A partner in a consulting firm since 1947, this graduate engineer is especially interested in piping, pumping, air, refrigeration and related mechanical, electrical problems. His series of articles are designed to supply answers operators and designers are seeking.

Quartet From Kellogg Includes World Traveler

J. J. Swift, S. R. Stiles, E. W. Howard and M. Tarnpoll, "New Hydroforming Unit Produces Petrochemicals and AvGas," page 105.

Combining the ideas, experiences and opinions of four informed men on one subject into one readable paper requires a great deal of rewriting, arranging and just plain work. In short it takes collaboration! And that's just what lies behind the article written by Swift, Stiles, Howard and Tarnpoll.

Morris (Mike) Tarnpoll heads the list of these qualified authors, who are all employed by The M. W. Kellogg. Beginning his career in 1935 with Warner-Quinlan Oil Company, Linden, N. J., Tarnpoll joined Kellogg in 1936 as control tester and gas analyst at the company's Jersey City laboratory.

One of the first assignments Tarnpoll handled for Kellogg was the establishment of a petroleum laboratory for training laboratory personnel in Texas. Since that time he has traveled to many parts of the world; one time as an advisor to operating departments in starting up commercial plants in various countries, another time as a technical advisor in connection with the operation of a hydroforming and aromatics plant for production of aviation gasoline, toluene and benzene in Brazil and Argentina. Since September, 1952, he has been manager of technical service for Kellogg, a newly established function.

Among Other Things, There's Always Sulfur

Seymour Schwartz, "Mexico's Sulfur Recovery Plant Ranks Second Largest in the World," page 95.

To say the least, Seymour Schwartz has an unusual assortment of hobbies, which includes listening to hillbilly and classical music, security analysis of extractive industry stocks and playing with his five-year-old daughter. But right at the top of this list is "sulfur!"

One look at Schwartz' career explains the high ranking of sulfur. Schwartz is today president of S. Schwartz & Associates, consulting engineers who specialize in the field of sulfur processing and recovery. Prior to the formation of this organization in 1952, he was associated with Allied Chemical & Dye Corporation, having the responsibility for the processing of sulfur and the design and operation of sulfur recovery plants in Mexico and the U. S. In collaboration with Arthur G. McKee Company, he was responsible for the design and operation of the world's second largest sulfur recovery plant in Mexico. A $2 million installation, it recovers 120 tons of sulfur a day.

Before his affiliation with Allied Chemical & Dye, Schwartz worked with Southern Acid & Sulphur Company in the design and construction of the first commercial Claus-type sulfur recovery plants ever constructed in the U. S.

This unusual hobbyist received a Bachelor of Chemical Engineering degree from Polytechnic Institute of Brooklyn in 1939, an M.S. in chemical engineering in 1940 from Illinois Institute of Technology, and completed additional doctoral work under a research fellowship at Virginia Polytechnic Institute.

Former Pill Roller Writes This One Solo

L. J. McGovern, "Statistical Quality Control—Applications and Limitations," page 121.

When last L. J. McGovern appeared in the pages of PETROLEUM REFINER he was a member of a three-man team. In this issue he is on his own in what shapes up as a top-notch effort.

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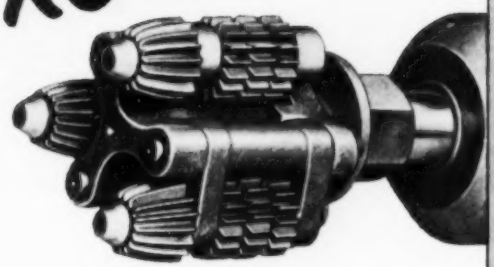

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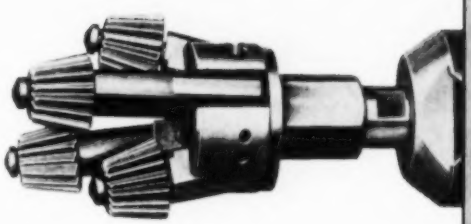

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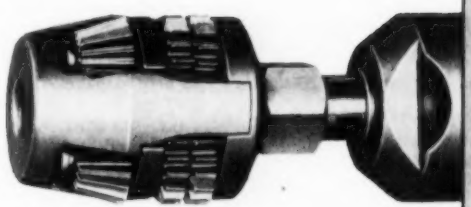
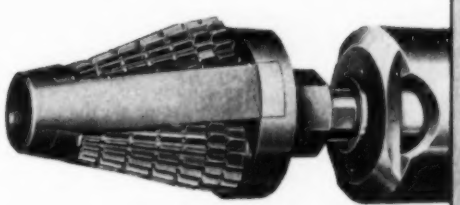


THE TYPE UD HEAD, widely used for its adaptability to average coke conditions.



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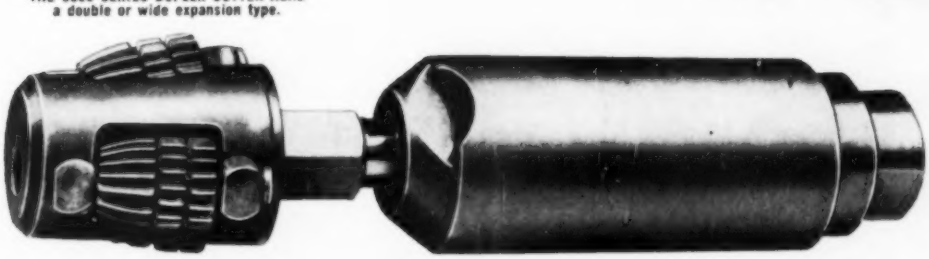

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Meet Our Authors

D. W. Beery

J. S. Bardin

E. J. Reeves

Medical Corps during World War II, McGovern was graduated from Kansas State College in 1948, B. S. degree in chemical engineering. In June of that year he joined Magnolia Petroleum Company, where he has since worked with process engineering, production scheduling of lubricating oils and waxes and catalytic cracking. He is still with Magnolia at Beaumont, Texas.

Married with one daughter, three years old, he relaxes with tournament bridge, gardening and an occasional game of golf.

Blaw-Knox Twosome Studies Synthetic Fuels

J. S. Bardin and D. W. Beery, "Producing Ammonia Synthesis Gas," page 99.

Since co-authors Bardin and Beery joined the Chemical Plants Division of Blaw-Knox Company, Beery in 1948 and Bardin a year later, both have been occupied with synthetic fuels and chemicals as well as low temperature processes.

Bardin received a B.S. degree in chemical engineering from the University of Texas in 1943, after which he became a process engineer engaged in the production of synthetic rubber at Firestone Tire and Rubber Company. Golf and photography fill his leisure hours.

Beery received a B.S. degree in chemical engineering from Newark College of Engineering in 1939 and an M.S. degree from Stevens Institute of Technology in 1942. When it's time out for relaxation, he takes to bridge, music or reading.

Reeves Writes Another

One look at the writings of E. J. Reeves should convince you that here is a man who doesn't lack when it comes to putting one word after another. Since 1948 he has written for PETROLEUM REFINER "Rotation Speed in Continuous Filter Operation," "Effects of Solvent Composition and Primary Solvent Dilution on Dewaxing Filter Rates and Wax Oil Contents," "Cycle Washing of Percolation Filters," and "Volumetric Contraction in Blending of Hydrocarbons."

All of this—which doesn't include the many other papers he has written for other publications—is by way of showing that the author of "Evaluating Viscosity Index Improvers," starting on page 139, knows what he's doing when he puts pen to paper.

A 1943 graduate of Rice Institute in chemical engineering, Reeves lists his experience as primarily in waxes and lubricants. It isn't unusual, therefore, that he is presently supervisor of the lubricating oil and wax section of the process control laboratories at Magnolia Petroleum Company. He joined Magnolia in 1943.

Thomas E. Corrigan

K. T. Beavers

J. G. Traxler

Process Engineer Enjoys Diversity

Thomas E. Corrigan, "New Process For Ethylene Oxide by Direct Oxidation," page 87.

Outdoor and indoor interests and degrees from three different schools go to make up the well rounded personality of this Cleveland native.

Few people are as diversified in hobbies as Corrigan, who enjoys equally outdoor camping, hiking, square dancing and creative writing. This mix-it-up turn to his nature is also evident in his education; he received his B.S. degree in chemical engineering from Fenn College, his M.S. degree in chemistry from the University of Michigan, and his Ph.D degree in chemical engineering from the University of Wisconsin.

For a time he worked at the Barrett Division, Allied Chemical & Dye Corporation, and at Wyandotte Chemicals Corporation. Then he returned to school; but this time as an instructor. He taught chemical engineering, both graduate and undergraduate courses, at West Virginia University. He is presently employed as process engineer at the Vulcan Engineering Division of Vulcan Copper & Supply Company.

Baytown Pair Join Humble After College

John G. Traxler and Knox T. Beavers, "Techniques for Cat Unit Turnarounds," page 112.

Individualists where hobbies are concerned, these two Humble Oil & Refining Company workers get together in an understandable way on cat unit turnarounds.

Traxler, assistant superintendent of maintenance and construction at Humble's Baytown, Texas, refinery, fills his leisure hours with hunting and handicraft in his home workshop, Beavers, with the shorter title of assistant zone supervisor at the same location, busies himself with photography and Jaycee activities (he's a past president!).

Both men joined the Humble organization in Baytown soon after being graduated from college. Traxler made the trip from the University of Texas, where he received his B. S. degree in electrical engineering in 1938 and his M. S. degree in engineering in 1939. Beavers, who was already living in Baytown, returned from Mississippi State College, where he was graduated with a B. S. degree in mechanical engineering in 1942.

Traxler has held various positions with Humble. Among them: metal inspector on several process units; construction inspector on the first fluid catalytic cracking unit; head of engineering and inspection department at the butadiene plant; and assistant general storekeeper, refining department.

Father of two daughters, two and four years old, Beavers has also compiled an impressive list of titles; construction inspector on the butadiene and butyl rubber plant; metal inspector for the butyl rubber plant; method study engineer; and cost analysis engineer.

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Fundamental Physical and Chemical Data—

Isobaric Heat Capacity of Propane Over a Wide Range of Temperature and Pressure.

JOHN H. SEIFARTH AND JOSEPH JOFFE (Newark College of Engineering, Newark, N. J.), *Ind. Eng. Chem.* **44** (1952), pp. 2894-7.

The authors review previous work on the heat capacity of propane and report on an investigation at elevated temperatures and pressures. The effect of temperature and pressure on the deviation of the isobaric specific heat of propane from that of the ideal gas state is given. The work covers pressures from 0 to 10,000 psia and temperatures from 200 to 1340 F. An equation is given that gives the deviation of the specific heat and which is based on the Benedict-Webb-Rubin equation of state. The results are also presented graphically. The various factors entering into the accuracy of the data are discussed.

Emission Spectra on Autoignited Heptane-Air Mixtures.

W. J. LEVEDAHL AND H. P. BROIDA (National Bureau of Standards, Washington, D. C.), *Analytical Chem.* **24** (1952), pp. 1776-80.

The explosive knock reaction in internal combustion engines is known to be caused by multistage autoignition, although the mechanism of the phenomenon has never been satisfactorily explained. The investigators developed an apparatus to obtain emission spectra on the cool-flame and hot-flame stages of autoignition in an internal combustion engine and to record total emission intensity as a function of time during the combustion cycle. It was found that the spectra of the cool-flame stage of n-heptane autoignition were identical with those of formaldehyde fluorescence. The hot-flame reactions showed CH and OH under all operating conditions, while the C_2 bands appeared in rich mixtures. Hydrocarbon flame bands were observed in lean mixtures. It was observed that the cool-flame intensity rose rapidly to a peak, and then decreased sharply before the onset of the more intense hot flame. The indication is that the entire cool-flame emission is caused by excited formaldehyde. Decrease in cool-flame itensity indicates that the rate of formation of excited formaldehyde reaches a maximum and decreases before the hot flame starts. The technique of oscillographically recording the intensity of filtered radiation detected by a photomultiplier tube was found to be extremely useful because of its simplicity, sensitivity, and reliability. A bibliography of 22 references is included.

Absolute Verdet Constants for Benzene Over a Range of Temperatures and Visible Wave Lengths.

ROBERT L. CUSTER AND CHAS. E. WARING (Department of Chemistry, University of Connecticut, Storrs, Conn.), *Jour. Am. Chem. Soc.* **74** (1952), pp. 5726-8.

The authors report the results of a study in which the absolute Verdet constants for the hydrocarbon benzene were determined over a range of temperatures and wave lengths, and, using a precision Faraday effect apparatus, and experimentally determined magnetic field strengths. The uncertainty in the values obtained was found to be ± 0.05 percent. The results constitute the first determination of the absolute Verdet constants for benzene. Data are given in detail in tabular and graphical form.

The Molecular Structures of Octafluorocyclobutane and of Methylcyclobutane.

H. P. LEMAIRE AND R. L. LIVINGSTON (Department of Chemistry, Purdue University, Lafayette, Ind.), *Jour. Am. Chem. Soc.* **74** (1952), pp. 5732-6.

The structures of the substances methylcyclobutante and octafluorocyclobutane were investigated by the method of electron diffraction using both radial distribution and visual correlation methods. The results indicate that C_4F_8 has a nonplanar carbon ring. The parameters are given. For methylcyclobutane the C-C distance in the ring was found to be 1.56 ± 0.03 A and the average C-C distance, 155 ± 0.02 A. The angle between the side chain bond direction and the bisector of the adjoining C-C-C angle in the ring, is given the value 130 ± 8° corresponding to a C-C-CH_3 bond angle of approximately 118°. It appears plausible on the basis of the results obtained, that the presence of the fluoron atoms caused the significant lengthening of the C-C distance. It appears probable that twice the van der Waals radious of fluorine represents the closest distance of approach of the fluorine atoms that are not attached to the same carbon atom.

Graphic Tracing of Reactions of Hydrocarbon Mixtures.

H. I. WATERMAN AND H. BODY (University of Delft, Holland), *Jour. Inst. of Petroleum* **38** (July, 1952), pp. 526-31.

A consistent and straightforward type description of a petroleum distillate would be a statement of what fraction of carbon atoms is present in aromatic rings, what fraction in naphthenic rings and what fraction in paraffinic chains. This has been termed structural carbon-group analysis. While the procedure gives no clue as to the manner in which the elements are linked together in the individual molecules actually present, it does give a picture of the "mean molecule," that is, a hypothetical molecule containing structural groups in the proportions in which they are present in the oil. These ring contents are calculated from refractive index, density, and molecular weight, measured at various stages of the process through which the oil is passing. Changes caused by the opening or closing of rings, hydrogenation or dehydrogenation, cracking and polymerization or alkylation can be conveniently followed by the use of a graph in which the aromatic-ring content is plotted against naphthenic ring content.

THESE abstracts prepared by DR. E. H. LESLIE and DR. H. B. COATS, The Leslie Laboratories, Traver Road, Ann Arbor, Mich., are selected from the current literature of science and technology, not including trade journals easily available. Photostatic copies of original articles can be obtained at nominal cost from The Library of Congress, Photoduplication Service, Washington 25, D. C. Complete or limited bibliographies covering special topics by title, by abstract or in complete manuscript will be prepared and furnished by arrangement with The Leslie Laboratories.

Chemical Composition and Reactions—

Elemental Sulfur in Crude Oil.

B. H. ECCLESTON, MARILYN MORRISON AND H. M. SMITH (Bureau of Mines, Bartlesville, Okla.), *Analytical Chem.* **24** (1952), pp. 1745-8.

The investigators observed that large amounts of hydrogen sulfide were evolved from certain crude oils at about 200 C. caused by the reaction of elemental sulfur with components of the oil. The elemental sulfur content of 17 crude oils was determined by a polarographic method believed to be accurate and to respond correctly to the presence of elemental sulfur in the oil. Particular attention was paid to the sampling and to the handling of the samples after they were received in the laboratory. The literature of the subject of elemental sulfur and crude oil is briefly reviewed, as well as methods for the determination of sulfur.

Identification of Cyclohexanethiol in Virgin Naphtha.

ROBERT C. ARNOLD, PHILIP J. LAUNER, AND ARTHUR P. LIEN (Research Department, Standard Oil Company [Indiana], Whiting, Ind.), *Analytical Chem.* **24** (1952), pp. 1741-4.

The thiols sulfur compounds are particularly detrimental in petroleum products because of their disagreeable odor, strong corrosion and deleterious effect on product stability. Up to the present time only aliphatic thiols have been identified in virgin petroleum stocks. In the investigation reported a combination of techniques involving chemical separation, distillation, chromatography, and infrared spectroscopy disclose the presence of naphthenic thiols as a major component of the petroleum thiols. Thiols in a high-sulfur virgin naphtha contain four to nine carbon atoms per molecule; 6- and 7-carbon thiols represent 40 and 25 percent, respectively, of the total thiol content. Cyclohexanethiol accounts for about 45 percent of the 6-carbon thiols or 18 percent of the entire thiols present in the naphtha. Further work will be done to study the 5-carbon and 7-carbon naphthenic thiols.

Composition of Gasoline From Coal Hydrogenation.

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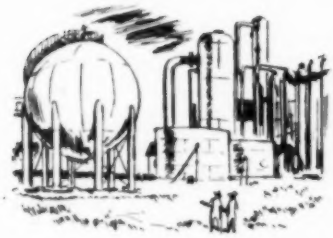

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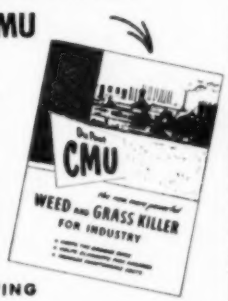

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(Synthetic Fuels Research Branch, Bureau of Mines, Bruceton, Pa.), *Ind. Eng. Chem.* **44** (1952), pp. 2852-6.

The oil studied was produced in a 200-barrel-per-day coal hydrogenation plant of the Bureau of Mines at Louisiana, Mo. The oil from the first or liquid phase stage of the hydrogenation is used as the feed to the second or vapor-phase stage of the process. The gasoline fraction so produced was examined, and also the gasoline fraction from the vapor-phase feed stock. Distillation and chromatography were used to isolate individual components. The analysis of the vapor-phase product showed C_6 to C_8 hydrocarbons approximately 58 percent. Of these 19 percent were paraffins, 50 percent naphthenes, and 31 percent aromatics, all being percents by weight. Thus the gasoline from coal hydrogenation can be a valuable source of benzene, toluene, and C_8 aromatics. The carbonization of one ton of dry ash-free coal can give about two gallons of benzene, but the same weight of coal processed by hydrogenation can yield about 18 gallons of benzene.

Manufacture: Processes and Plant—

Pressure Drop in Annuli Containing Transverse Fin Tubes.

F. W. Braun, Jr., and James G. Knudsen (Oregon State College, Corvallis, Ore.), *Chem. Eng. Progress* **48** (1952), pp. 517-22.

The purpose of the investigation on which a report is made was a study of the pressure drop of water flowing in annuli containing transverse fin tubes. Although the pressure drops in annuli between smooth tubes are well established, little is known of the phenomena in fin tubes. Determinations were made in the range of Reynolds numbers from 260 to 63,000. When the flow was turbulent, the maximum friction factors occurred when the fin spacing was four to five and one-half times the fin height. Charts are presented that can be used to predict friction factors in annuli containing transverse fin tubes. The plots were used to predict friction factors for helical fin tubes investigated by other workers, and errors of ±15 percent in the predicted values were found in most cases.

Heat Transfer to Boiling Liquids at Low Temperatures and Elevated Pressures.

A. G. Monroe, H. A. S. Bristow and J. E. Newell (British Oxygen Company, Morden Road, London S.W. 19), *Jour. Applied Chem.* **2** (1952), pp. 613-24.

Previous work on heat transfer to boiling liquids is reviewed, and the variations in the heat-transfer coefficient with temperature difference across the film are described in reference to the boiling mechanism and the physical properties of the fluid. In the boiling of liquids there are four distinct regions in which the process possesses different characteristics, depending on the temperature difference across the film. These are defined as convective, nucleate, metastable and stable film-boiling regions. In the first two types heat transfer is governed by the properties of the liquid phase. In the last two types the gas phase exists in appreciable quantities within the boiling liquids. The authors report on an experimental study of heat transfer to oxygen and nitrogen boiling inside tubes at pressures from atmospheric to 2000 psi. Air was used as the heating medium. Because of the large temperature difference, all measurements fell within the metastable film boiling range. At the higher pressures used, which exceeded the critical pressures, the transitions from liquid to vapor occurred without separation of the phases. Under all conditions the boiling coefficient was found to diminish with increasing temperature difference, and to improve with increasing fluid flow rate. At pressures above the critical the rate of heat transfer is affected by the absolute temperature of the fluid.

Effect of Temperature Variation Around a Horizontal Condenser Tube.

LeRoy A. Bromley, Robert S. Brodkey and Norman Fishman, *Ind. Eng. Chem.* **44** (1952), pp. 2962-6.

It is known that there is a large variation in temperature around a horizontal condenser tube. The purpose of the investigation was to study both theoretically and experimentally the error introduced in the calculations by the assumption of a constant tube temperature. The experimental temperature variations found agree well with those predicted. Although the temperature variation about a tube may be large, the heat transfer coefficient calculated by use of an average tube temperature was found to be essentially correct. Thus, for the design of atmospheric condensers, one can use the Nusselt equation with his assumed constant tube temperature replaced by the usual arithmetic average temperature. The data are presented in considerable detail in tabular and graphical form, and a diagram of the apparatus used is included.

Effect of Heat Capacity of Condensate.

LeRoy A. Bromley (Department of Chemistry and Chemical Engineering, University of California, Berkeley, Calif.), *Ind. Eng. Chem.* **44** (1952), pp. 2966-9.

Heat transfer coefficients for condensation at high pressure, under conditons such that the sensible heat transferred from the condensing film is comparable to or larger than the latent heat, cannot be calculated accurately by the Nusselt equation. The author presents a modification of the equation which enables one to calculate the heat transfer coefficient. However, no adequate data at high pressures were available to test the equation. The derivation was also applied to film boiling. It is believed the equations should be of aid in the more accurate sizing of condensers that are to be operated at high pressure.

Absorption of Carbon Dioxide From Air by Sodium and Potassium Hydroxides.

Harold A. Blum, Leroy F. Stuzman and Wayne S. Dodds (Northwestern Technological Institute, Evaston, Ill.), *Ind. Eng. Chem.* **44** (1952), pp. 2969-74.

An equation was developed for representing the process of gas absorption in which both a physical absorption and a chemical reaction are involved. The equation opens new possibilities in the method for representing gas absorption processes of this type. It correlates the data with a mean deviation of 11 percent and a maximum deviation of 32 percent. It was found that the constant K in the equation is independent of gas rate and packing size, nearly independent of the partial pressure of carbon dioxide within the range of data, increases with normality up to 1.5 N, beyond which it decreases slightly, and is higher for a potassium hydroxide than for a corresponding sodium hydroxide solution. The data are presented in detail in tabular and graphical form and a bibliography of 25 references is included.

The Mechanics of Drops.

R. R. Hughes and E. R. Gilliland (Massachusetts Institute of Technology, Cambridge, Mass.), *Chem. Eng. Progress* **48** (1952), pp. 497-504.

As a first step in a general study of mass transfer in fluid particle systems, the authors made a review and analysis of the mechanics of drops. This covers both the gross motion of drops and the detailed motion in and around individual drops. The emphasis is on new concepts and correlations in connection with the effect of acceleration on drag, the equilibrium distortion of drops, and the internal circulation caused by skin friction. A mathematical development of the subject is presented. A typical problem is stated and the solution is outlined. A bibliography of 28 references is included.

High Molecular Weight Polymers From Propylene and 1-Butene.

C. M. Fontana, R. J. Herold, E. J. Kinney, and R. C. Miller (Socony-

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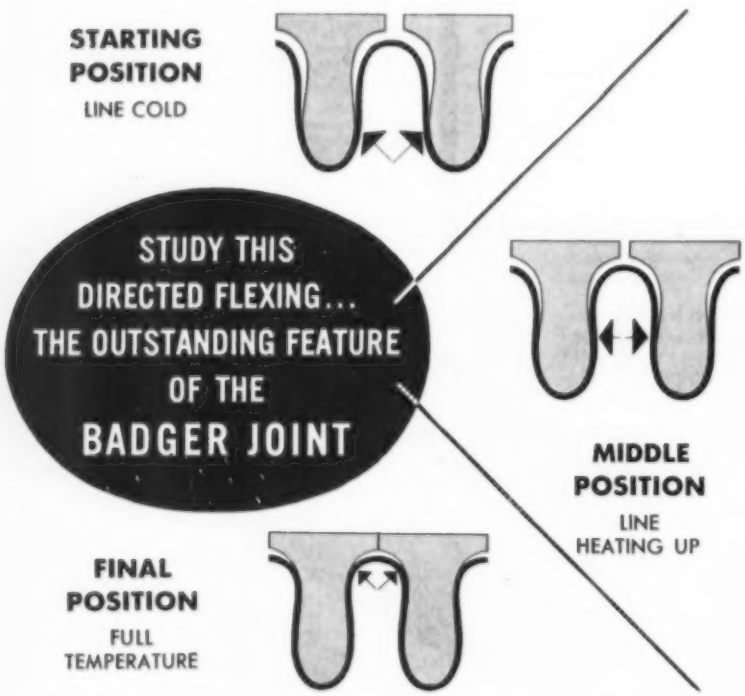

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[Science Abstracts]

Vacuum Laboratories, Research and Development Department, Paulsboro, N. J.), *Ind. Eng. Chem.* **44** (1952), pp. 2955-62.

The object of the work was to obtain polymers of high molecular weight from the low molecular weight 1-olefins, particularly propylene, by modification of polymerization procedures previously used. The higher molecular weight polymers were obtained from propylene and from 1-butene by using promoted aluminum bromide catalyst in a "semi-batch" procedure in which the reaction was initiated by simultaneously feeding the olefin-catalyst solution and promoter over a time interval into a batch vessel, following which the olefin addition was continued in order to give a product of optimum molecular weight. A further procedure was the "semi-continuous" polymerization of propylene in which a small part of the olefin was first polymerized in a continuous stage, after which the reaction was completed in a batch stage. Similar products were made in a multistage continuous process, each stage of which was a continuous reactor. Polypropylenes of high molecular weight, and effective as viscosity index improves for motor oils, were made by these methods. The results obtained are explained on the basis of a hydride ion transfer mechanism.

Control of the Physical Structure of Silica-Alumina Catalyst.

K. D. ASHLEY AND W. B. INNES (Stamford Research Laboratory, American Cyanamid Company, Stamford, Conn.), *Ind. Eng. Chem.* **44** (1952), pp. 2857-63.

The effects of the various variables in the process of preparing the silica-alumina catalyst were studied. To better understand the products, fundamental studies were made both on silica-alumina gel and on silica colloid and gel precursors of the product.

Electron micrographs indicate that the ultimate particles are spheroidal. The silicic acid content of the silica hydrogel correlates with the surface area of the dried gel. The data indicate that when alumina is added, a part of the silicic acid reacts with an equimolar amount of aluminum hydroxide to form a surface layer complex. The porosity of the catalyst increases with time, temperature and pH of silica gel aging and is relatively insensitive to treatment which is subsequent to alumina addition. Increasing porosity increases thermal and steam stability, but decreases attrition resistance. The authors believe that the investigation makes it possible to tailor-make silica-alumina catalysts for best performance.

Percolation Decolorization of a Lubricating Oil Fraction by Fuller's Earth.

W. T. GRANQUIST AND H. J. STREICH (Floridin Company, Warren, Pa.), *Ind. Eng. Chem.* **44** (1952), pp. 2898-2903.

The paper presents the results of a study of the percolation decolorization of a steam-refined cylinder stock from Pennsylvania grade crude oil by fuller's earth from Gadsden County, Fla. The stock was decolorized in solution, 40 percent by volume stock and 60 percent by volume heavy naphtha. The effect of clay activation temperature on the adsorption system indicates a decrease in

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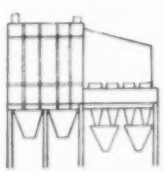

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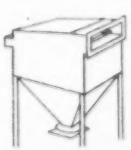

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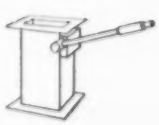

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the amount of resin adsorbed and a general increase in the molecular weight of the benzene-soluble resin with increase in activation temperature. The distribution of weight adsorbed and molecular weight along the adsorption column, in experiments run to increasingly darker effluent colors, indicate a displacement of high molecular weight resin downward along the column. Definite fronts were observed in the molecular weight curves. A procedure based on optical density of the feed and decolorized oils was developed in order to obtain a mathematical representation of the data. This should have value in calculations for predicting filter operation and possibly for use in the test evaluation of clays.

Industrial Viewpoints on Separation Processes, Part II.

K. H. Hachmuth (Phillips Petroleum Company), *Chem. Eng. Progress* **48** (1952), pp. 570-4.

The article is Part II in a series of three articles on separation processes. It deals with separation as made by fractional distillation, or in general those requiring countercurrent flow of two phases. The author urges the use of the same set of symbols in connection with fractional distillation, extractive distillation and solvent extraction, because this demonstrates the similarity of the processes. The methods of separation in countercurrent separation processes are discussed. A bibliography of 37 references is included.

Products: Properties, Utilization And Analysis—

Vapour and Air Release From Aviation Fuels.

L. D. Derry, E. B. Evans, B. A. Faulkner and F. C. G. Jelfs, *Jour. Inst. of Petroleum* **38** (1952), pp. 475-525.

The paper deals with two characteristics of fuels for jet-propelled aircraft, namely, the formation of vapor and the relief of dissolved air from the fuel at high altitudes. Although these problems presented some difficulty in piston-engined aircraft, the problems have been made more acute because of the much faster rate of climb and higher operational ceilings of the jet-propelled craft. The problem of air release is mainly one concerned with field of low volatility and vapor pressure, such as kerosine. Vapor release is a problem with fuels of relatively higher volatility and vapor pressure, such as aviation gasolines. The paper gives the results of experimental work designed to determine the magnitude and importance of air release from the two types of fuels and to relate the results obtained to normal fuel inspection data and, as far as possible, to practical operating conditions. Some methods of overcoming some of the difficulties are suggested.

Products from Hydrocarbon Synthesis.

C. E. Morrell, C. S. Carlson, J. H. McAteer, R. F. Robey and P. V. Smith, Jr. (Esso Laboratories, Standard Oil Development Company, Linden, N. J.), *Ind. Eng. Chem.* **44** (1952), pp. 2839-43.

Although it is not generally expected

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Effect of Temperature on Condenser Tube Corrosion

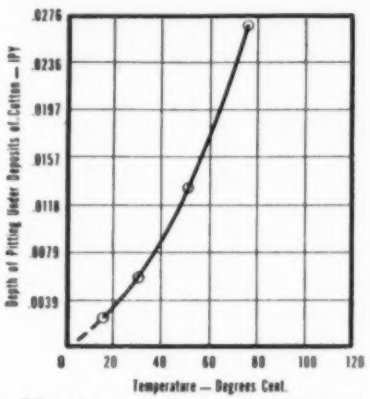
Heat accelerates practically all chemical reactions. Qualitatively, it may be said that a temperature rise of the corroding solution of about 35°F will double the rate of corrosion. The effect of temperature varies with the character of the circulating water, the nature of the corrosive medium, and the condenser or heat exchanger tube alloy involved.

For this reason many plant engineers keep a temperature record of incoming and outgoing condenser waters, because it is realized that a unit operating at too high a temperature will fail prematurely.

The higher temperature of cooling waters during the summer of the year is also one of the factors contributing toward more rapid condenser tube corrosion during this season. Instances have been reported where new condenser tubes installed during the cold winter season have given longer service than new tubes installed during the warm summer. This difference in performance occurs because the type of protective film which forms on a metal in cold water is generally thinner and of a more continuous nature than that which forms in warm water.

In warm and hot waters, the susceptibility towards pitting and dezincification generally increases appreciably. Due to pitting, the useful life of a condenser tube may be considerably shorter than that indicated by the over-all corrosion rate as evaluated by loss in weight or loss in tensile strength. This pitting may be substantially increased by the presence of sulfides in the cooling water especially during the summer season.

In certain waters, the corrosion rate drops off with an increase in temperature because the water deposits a scale. Calcium carbonate forms as a result of the decomposition of calcium bicarbonate at elevated temperatures. If a continuous deposit of calcium carbonate forms, it may protect the underlying metal. However, if breaks occur in this type of impervious scale, pitting is likely to take place on the exposed areas



Effect of temperature on rate of corrosion of Admiralty Brass in 3 per cent sodium chloride solutions.

especially when the water velocity is high.

Unfortunately, the build-up of a thick scale on the inside of a water heating coil, boiler or condenser tube seriously interferes with heat transfer. This loss in heat transfer results in considerably higher temperatures on the metal surfaces facing the hot gases or liquid. The high temperature often leads to more rapid corrosion as well as thermal stressing (bending and buckling) and lowering of the creep strength of the metal (cracking or intergranular failures).

Influence of Temperature on Intergranular Corrosion

Corrosion sometimes tends to follow the grain boundaries of the metal to a depth of only a few thousandths of an inch which is generally of no serious consequence. However, where intergranular corrosion penetrates the tube wall, it destroys the usefulness of the tube. This condition is most acute in the hottest zone of heat exchangers and condensers when hot corrosive gases are handled.

Intergranular corrosion may also occur on the water side of the tube when the water velocity is low, resulting in a correspondingly high tube wall temperature.

The preventive measure is to maintain a low tube wall temperature — either by increasing the water flow and to remove trash which blocks the tubes. Under these conditions all of the standard copper-base condenser tube alloys give satisfactory service.

However, if a very high water velocity is needed to lower the tube wall temperature, then in order to avoid impingement corrosion, Aluminum Brass, Aluminum Bronze and Cupro Nickel alloys may be needed.

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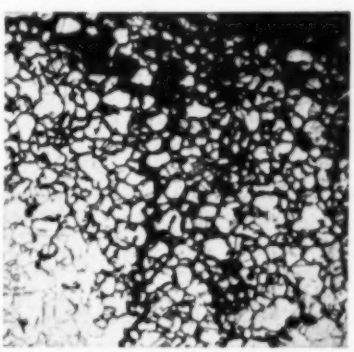

Intergranular corrosion. Micrograph mag. 75X.

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INSULATION FOR HIGH & LOW TEMPERATURE

[Science Abstracts]

that the synthesis process will be either required or extensively utilized for the production of liquid fuels, the process should have a major impact on the aliphatic organic chemical industry. The purification methods developed for the products made in the synthesis procedure should have application in existing chemical processes. The purpose of the present paper is to provide a summary of the work done in the Esso Laboratories on the recovery, analysis and purification of the oxygenated compounds produced in the hydrocarbon synthesis process. A second purpose is to serve as a background for a more detailed presentation of certain phases of the work relating to the separation and purification of oxygenated compounds obtained in the synthesis process.

Classification of Bitumens in Asphalt Technology, Part V.

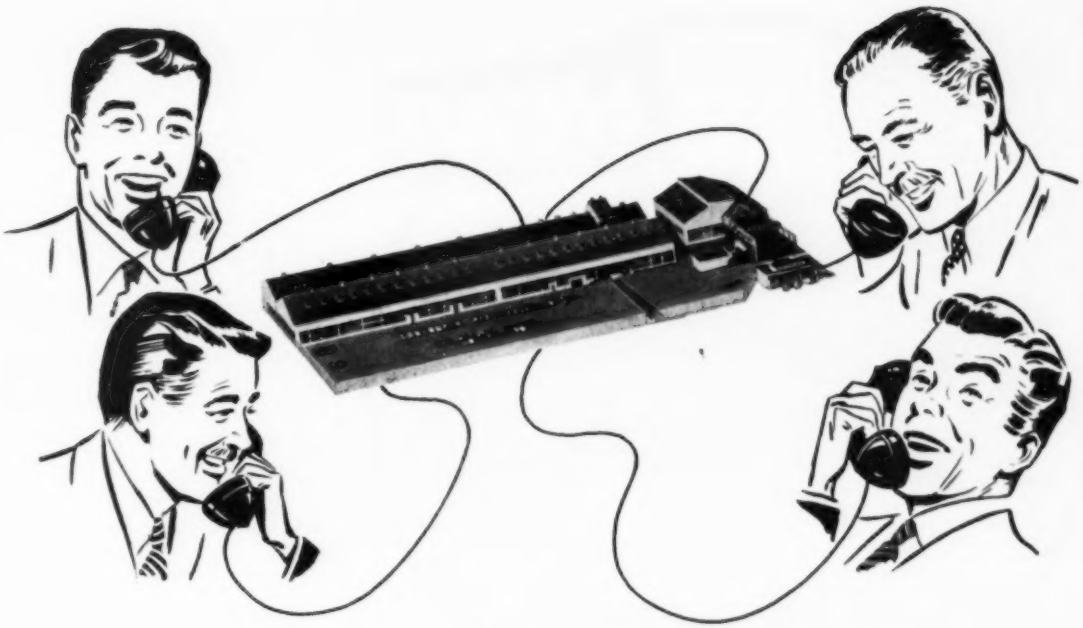
S. L. Neppe, *Jour. Inst. of Petroleum* **38** (July, 1952), pp. 532-57.

Three types of asphaltic bitumens were studied in the investigations, including severely cracked, slightly cracked, and natural bitumens. To determine the effect of air-blowing as against steam refining, both procedures have been studied for each group. A new "Penetration Susceptibility Factor" has been adopted to cover the temperature range over which penetration from 100 to 10 and a ductility susceptibility factor is defined as the temperature range over which ductility changes from 100 to 1. Both factors are approximately proportional to Softening Point Number, but since they are materially affected by the consistency of the bitumen they should be regarded only as supplementary to the Softening Point Number or related indices. The effect of air-blowing on the natural bitumen is shown to be more pronounced than on cracked types. Composite diagrams show simultaneously the relationship to temperature of penetration, ductility, and softening point properties. Once these characteristics have been established for any class of material, the relevant chart can be used directly for deducing the penetration or ductility at any temperature and for any member of that series. There is an independent characteristic mathematical relationship for the penetration at the softening-point temperature for each series of bitumen.

Determination of Sulfur in Petroleum Distillates by X-Ray Absorption.

A. Y. Mottlau and C. E. Driesens, Jr. (Esso Laboratories, Linden, N. J.), *Analytical Chem.* **24** (1952), pp. 1852-4.

The authors describe a procedure for the determination of sulfur in petroleum distillates using the general electric x-ray photometer. This photometer was designed specifically for absorption work. The authors estimate that the man hours saved by the use of the procedure has been sufficient to pay for the instrument in less than eight months. One operator can run 30 to 40 sulfur determinations in a day. One determination requires about ten minutes. The accuracy of the method is well within the limits required for the great bulk of samples submitted to the laboratory, not including, of course, gasolines—the sulfur content of which is too low to be measured by the



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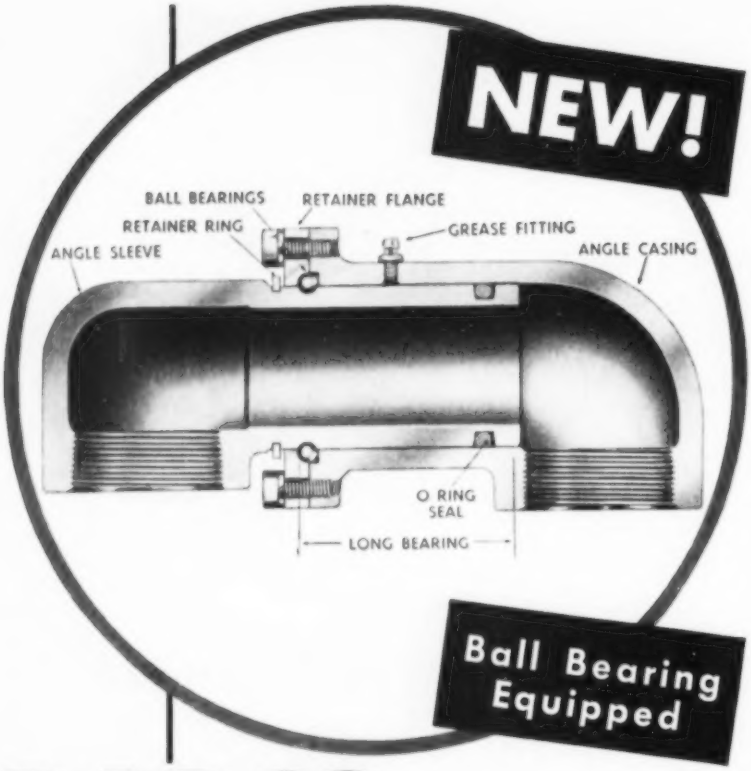

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[Science Abstracts]

present x-ray method.

Determination of Nitrogen in Petroleum and Shale Oil.

A Report of the Subcommittee on Nitrogen Determination, Committee on Analytical Research, Division of Refining, American Petroleum Institute.

G. R. LAKE (Union Oil Company, Brea, Calif.), *Analytical Chem.* **24** (1952), pp. 1806-11.

Importance of better methods of determining nitrogen in crude petroleum is stressed on account of the deleterious effect of nitrogen compounds on cracking catalysts and the indication that they contribute to gum formation in gasolines. Fourteen laboratories collaborated in the two-year study, of which this paper is a report. The work has demonstrated that nitrogen in petroleum and shale oil can be accurately determined by several methods if careful attention is given to control of the variables. Digestion temperature must be maintained at about 700 F. for one hour in the Kjeldahl method. Mercury is the preferred catalyst for use in this method. Twenty determinations can be made per man-day. In the Dumas method meticulous burning is required to assure complete combustion. The gas-recycle, double furnace, and mass spectrometer correction modifications provide safety features to prevent or correct for improper combustion. The ter Meulen catalytic hydrogenation method is applicable to lower concentrations of nitrogen than the Dumas method. Fourteen determinations can be made per man-day. Results of the work are presented in detail in tabular and graphical form and a bibliography of 24 references is appended.

Determination of Trace Metals in Petroleum Fractions.

J. H. KARCHMER AND E. L. GUNN (Humble Oil & Refining Company, Baytown, Texas), *Analytical Chem.* **24** (1952), pp. 1733-41.

The authors criticize the methods for determination of trace metals that are based on combustion of the oil with subsequent determination of the ash residue. Possible errors through the loss of ash matter are great and excessive time is required for the analysis. A procedure was developed in which by rigid control of the variables in combustion and ignition a reproducibility of ±10 percent in the ash range of 0.001 to 0.01 percent was obtained and ±5 percent in the range 0.01 to 0.3 percent. Colorimetric and spectroscopic methods have proved adequate for determining metals in milligram quantities of ash substance, the relative precision of these methods being ±10 to 20 percent. Spectroscopic methods provide an accuracy of ±20 percent and can be applied to the direct determination of trace metals in certain stocks in order to avoid some of the problems connected with indirect chemical methods.

Application of ter Meulen Nitrogen Method to Petroleum Fractions.

JOSEPH HOLOWCHAK, G. E. C. WEAR AND E. L. BALDESCHWIELER (Esso Laboratories, Linden, N. J.), *Analytical Chem.* **24** (1952), pp. 1754-7.

There has long been a great need for

a procedure to determine nitrogen present in small amounts in petroleum feed stocks and products. The Dumas and Kjeldahl methods are not completely suitable because of several inherent difficulties. Many of the compounds present are particularly refractory to Kjeldahl digestion. The ter Meulen method has been generally accepted in Germany and has been successfully applied to the determination of nitrogen in various products. The method is based on the fact that when an organic compound containing nitrogen is vaporized and cracked in a stream of hydrogen and the products passed over a nickel catalyst at 280 to 300 C., nitrogen is quantitatively converted into ammonia that can be absorbed and determined by the usual methods. Preparation of the catalyst is described, as well as the apparatus used for the determination. Results are presented for the application of the method to a variety of compounds, including gas oil with various cyclic nitrogen compounds added to it. Materials containing as little as 0.01 percent nitrogen can be analyzed and by the application of more delicate colorimetric methods the authors believe it should be possible to extend the method to yield results in the range of 0.001 percent ammonia nitrogen with an accuracy of better than 5 percent.

Determination of Trace Metals in Crudes and Other Petroleum Oils.

Analysis for Iron, Nickel, Vanadium and Copper.

O. I. Milner, J. R. Glass, J. P. Kirchner and A. N. Yurick (Research and Development Department, Socony-Vacuum Laboratories, Paulsboro, N. J.), *Analytical Chem.* **24** (1952), pp. 1728-32.

The increasing concern of the petroleum industry with traces of metals in crude oils because of the effect of these substances on catalysts has required the development of quantitative methods for their determination. The authors report on a procedure for the decomposition of petroleum oils and the analysis of the resulting ash for iron, nickel, vanadium and copper. The procedure is such as to minimize risk of loss of the metals in the ashing process. The ash is dissolved and separate portions of the solution are taken for the determination of the individual elements. Iron, nickel and vanadium are determined photometrically. Copper is determined polarographically. The method has been applied to a number of typical petroleum stocks and its effectiveness in determining material balances in refining processes was demonstrated. The trace metal contents of a number of typical crude oils are given.

Foushee and Martin Appointed At Standard (Indiana) Lab

Standard Oil Company (Indiana) has appointed Fred W. Foushee assistant personnel supervisor and G. T. Martin group leader at the company's Whiting, Ind., research laboratory.

Foushee joined Standard in 1949 as a chemist. Martin, who is in charge of technical service work on light oils distillation and coking processes, joined the company in 1949 as a chemical engineer.

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What's New in Manufacturers' Literature

For copies of the catalogs and new equipment literature listed, use one of the convenient Reader Service Postcards on this page. Just circle the number on the card corresponding to the number of the item in which you are interested.

Refractories and Concrete

Two new bulletins, "'Gunite' Refractories" and "'Gunite' Concrete" have been published by Gunite Concrete and Construction Company.

The former folder, referred to as Bulletin No. 500, describes "Gunite" refractories and their adaptability in refineries, power plants, steel mills and industrial plants. A specification chart for Gunite refractory and insulating linings is included.

The latter publication, called Bulletin No. 10, treats "Gunite" concrete in a similar fashion, giving advantages, applications and comparative applications of the concrete through schematic illustrations. Standard specifications for many of the product's uses are given in charts.

Circle No. 1 on Postcard

Lustrex X-820 Applications

Revised technical information on Lustrex X-820, a carboxyl containing polyelectrolyte resin, is offered by the product development department of Monsanto Chemical Company's plastics division in a new bulletin.

Still in the development stage, Lustrex X-820 is finding broad application in organic and water systems. Included in the bulletin and data sheet are suggested fields of application. Samples of the material are available.

Circle No. 3 on Postcard

Electrode Rapping System

A new six-page bulletin giving information on the recently developed M.I. (Magnetic impulse) continuous electrode rapping system for electrostatic precipitators has been made available by Research Corporation.

M.I. is a self-monitoring electrode cleaning system that improves overall precipitator efficiency. Operation of this system is explained with circuit diagrams and photographs of major components in the new folder.

Circle No. 4 on Postcard

Oil Hose Specifications

B. F. Goodrich Company has made available a new eight-page catalog on its oil hose. The catalog describes nine types of oil hose for use in refineries and distributing terminals, on oil tankers and barges, for loading and unloading oil cargoes, or other services where flexible connections are necessary.

The booklet lists hose specifications, describes materials and methods used in construction and tells recommended uses.

A detailed description of B. F. Goodrich oil hose fittings and sparkproof nipples and flanges is also given.

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What's New in Manufacturers' Literature

Use one of the free and convenient Reader Service Postcards on this page to request copies of the catalogs in which you are interested.

Spray Nozzles Details

Bulletin 6-A, issued by Shutte and Koerting Company, gives complete technical details on the company's line of atomizing and spray nozzles. Separate sections of the publication are devoted to atomizing nozzles, spray nozzles and spray nozzle clusters.

Information given for each type of spray nozzle includes construction details, spray characteristics and capacities. Dimension tables, capacity charts and drawings supplement the text material.

Circle No. 5 on Postcard

Thin Wall Construction

A new 12-page bulletin describing Bigelow-Liptak thin wall construction for industrial furnace enclosures has been made available.

The booklet features photos and engineering drawings showing the thin, insulated walls as used for boilers, refinery heaters, dryer furnaces and cement kilns.

Circle No. 6 on Postcard

Climax Controls Revised

Revised Sections 105 and 110 for Black, Sivalls & Bryson, Inc., Climax Controls Catalog have been released. Pages 3, 4, 5 and 6 of the old Section 110 have remained the same.

Circle No. 7 on Postcard

Spraywelding Ways and Means

A revised four-page bulletin describing the Colmonoy spraywelder and sprayweld process is now available. Latest developments in spraywelding equipment and technique that enable powdered Colmonoy hard facing alloys to be fusion-bonded to metal parts are given. According to the company the bonding is a three-step process which provides surfaces that are non-porous and resistant to wear, heat, erosion and corrosion.

Properties of three Colmonoy alloys adaptable to spraywelding which have Rockwell C hardnesses ranging from 35 to 61 are included.

Circle No. 8 on Postcard

Chemical Family Description

"Carbowax Polyethylene Glycols" published by Carbide and Carbon Chemicals Company, a division of Union Carbide and Carbon Corporation, describes the varied uses of the water-soluble liquid and solid polyethylene glycols, and the methoxy polyethylene glycols in the rubber, pharamaceutical, textile, metal and other industries. The use of these compounds in cosmetics, cleaners, adhesives, resins and paper products is also discussed.

One section of the book is devoted to the technical and U.S.P. specifications of the polyethylene glycols as they are shipped by Carbide and Carbon.

Circle No. 9 on Postcard

Ethylbenzene Data

A booklet bringing together chemical, physical and reaction data on ethylbenzene, a highly reactive aromatic hydrocarbon, has been published by Monsanto Chemical Company's Texas division.

In addition to complete specifications, the publication contains a series of selected typical reactions, starting with ethylbenzene and demonstrating a wide range of suggested uses.

Circle No. 10 on Postcard

(More Literature Items on Pages 161, 163, 165, 167)

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[What's New in Equipment]

Teflon Impregnated Asbestos

To achieve greater resiliency in the ordinary white braided asbestos teflon impregnated packing, Flexrock Company has braided several jackets of quality asbestos yarn thoroughly impregnated with teflon over a braided or twisted core of teflon impregnated glass fiber. The resiliency results in a better seal and longer life.

The improvement is most pronounced on high speed centrifugal acid pumps, where solid braided teflon impregnated packing has a tendency to heat up due to its lack of resiliency.

The new construction has developed a packing which is almost like rubber in the larger sizes.

Circle No. 11 on Postcard

Non-Slip Handwheel

A new "non-slip" handwheel has been patented and is being introduced by The Lunkenheimer Company. Designed to turn easily and safely, it represents a departure from the conventional type of valve wheel it replaces.

Made of malleable iron, as was its predecessor, the handwheel features four finger-spaced lugs, all continuations of the strong spoke structure, projecting from the stem hub through a rugged octagonal frame. The shape of the handwheel is designed to eliminate the possibility of a burned hand from contact with the valve stem.

This item supplements The Lunkenheimer Company data on pages 685-688 of The Refinery Catalog, 20th Edition.

Circle No. 12 on Postcard

Boiler Level Indicator

A major safeguard in plant safety programs is modern instrumentation, such as The Foxboro Company's 12-inch dial indicator which eliminates a common hazard in the boiler room.

This indicator operates on the differential pressure principle. It can be mounted on a panel or pipe standard, bringing the dial to convenient eye level to inform the operator constantly of water level conditions. Large white numerals and micrometer pointer against a black dial provide accurate reading even at a distance.

Circle No. 13 on Postcard

Utility Blower Line

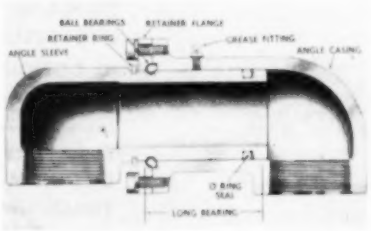
To Hartzell Propeller Fan Company's complete line of propeller-type fans and blowers have been added centrifugal blowers designed to meet a wide variety of air-moving needs.

Included in the new line of utility blowers are belt-drive models in sizes from 9 to 30 inches, direct-drive models in sizes from 4½ to 12 inches, high pressure blowers in sizes from 8 to 12 inches and others.

Hartzell's new 24-page blower catalog B-10 gives descriptive material and dimension drawings on each model and complete air delivery tables.

This item supplements Hartzell Propeller Fan Company data on page 580 of The Refinery Catalog, 20th Edition.

Circle No. 14 on Postcard



Ball Bearing Swing Joints

A new line of ball bearing equipped swing joints for use on loading and unloading lines handling oil, gasoline, chemicals and other liquids has been introduced by Barco Manufacturing Company.

The design of the new line is distinguished by a long lubricated bearing which provides adequate support for piping. An exclusive method of positioning the ball bearings prevents them from falling out when the joint is taken apart. Sealing is by means of an "O" ring in a recess in the sleeve of the joint.

The new joints are being produced in 11 styles and are offered in steel for refinery, railroad and other heavy duty service.

Detailed information on the swing joints is contained in the company's new Catalog No. 400.

This item supplements Barco Manufacturing Company data on page 190 of The Refinery Catalog, 20th Edition.

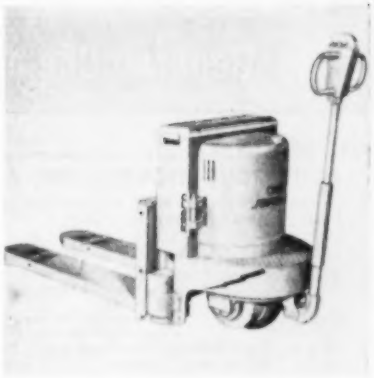
Circle No. 15 on Postcard

Versatile Turntable

A "turntable with a brain" has been developed by Gale Dorothea Mechanisms. Called the "Flexi-Turn," this new production tool is controllable from a remote point, instantly reversible and variable in speed from 0 to 20 rpm.

The Flexi-Turn's versatility makes it adaptable to such production processes as testing, gauging, inspecting, packaging, soldering and assembly.

Circle No. 16 on Postcard



1953 Model Pallet Trucks

The 1953 models of Clark Equipment Company's Powrworker lift-truck line will be of interest to those who require close-quarter, low floor-load capacity handling equipment. The new models are pallet trucks, electric battery-powered, with a capacity rating up to 6000 pounds. These pallet trucks can be supplied with pallet forks to handle any size pallet, single or double faced.

Optional models are available in either the "walk-it" or "ride-it" version. One is arranged for single tray (1 x 6) layout of battery, while the other accommodates a double tray (3 x 3) layout of battery.

The new units feature double hoisting cylinders for lifting the loaded pallet, motor-in-wheel drive, full time delay control with all contactors interlocked, positive safety-spring return handle which applies the brake and cuts off power, and a bumper guard to avoid operator injury.

Circle No. 17 on Postcard

Precision Bored Meter Runs

Bulletin No. 1701, issued by the piping department, Dravo Corporation, describes the advantages to be gained by installing precision bored tubes in connection with flowmeter orifices. The precision machine bored meter run gives standardized performance and permits the use of a beta ration, according to the folder.

Circle No. 18 on Postcard

New Microwave Equipment

Westinghouse Electric Corporation has made available a new 2000-mc microwave system that utilizes microwave radio (Type FR) and frequency-division multiplex equipment (Type FJ).

The microwave carrier is divided into 30 voice channels or equivalent telegraphic functions (15 per voice channel) by the Type FJ multiplexing equipment. This equipment was designed specifically for use with the microwave equipment and provides maximum flexibility of arranging various combinations of services on the channels.

Complete point-to-point systems are offered, including all types of interconnected terminal equipment.

Circle No. 19 on Postcard

CHEMICAL USERS' GUIDE

to General Chemical Products for the Petroleum Industry

ALKYLATION

ANHYDROUS HYDROFLUORIC ACID

Grades or Strengths: 99.0% HF min. (one grade only)
Packing: Steel Cylinders, Tank Cars

SULFURIC ACID

Grades or Strengths: Standard
66° Baume—93.19% H_2SO_4
99% H_2SO_4
Diamond—66° Baume
Crystal—66° Baume
Packing: Tank Barges, Steel Tank Cars, Steel Tank Trucks, Steel Drums, also Carboys

POLYMERIZATION or ALKYLATION

FLUOSULFONIC ACID—$HO.SO_2F$ (HSO_3F)

Grades or Strengths: Min. Content 98% Fluosulfonic Acid
Packing: Steel Tank Cars, Steel Drums

BORON TRIFLUORIDE

Gas: Cylinders
Etherate Complex: 47.9% min. BF_3. Packing: Steel Drums, Tank Trucks, Tank Cars
Phenol Complex: 26.3% Max. BF_3. Packing: Steel Drums, Tank Cars
For Bulk Quantities write Baker & Adamson Products, General Chemical Division, Allied Chemical & Dye Corporation, 40 Rector St., New York 6, N. Y.

SULFONATION

SULFURIC ACID

SULFAN® "B" (Stabilized Sulfuric Anhydride)
Grades or Strengths: 99% SO_3 min.
Packing: 55 Gal. Drums, Tank Cars

OLEUM

Grades or Strengths: 15% free SO_3 (103.38% H_2SO_4)
20% free SO_3 (104.5% H_2SO_4)
65% free SO_3 (114.38% H_2SO_4)
Packing: Steel Drums, Tank Cars, Tank Barges, Tank Trucks

ISOMERIZATION

MURIATIC ACID (Hydrochloric)

Grades or Strengths: Standard—18°, 20°, and 22° Baume
Packing: Rubber-lined Tank Cars, Rubber-lined Tank Trucks, also Carboys

DETERGENTS & BUILDERS

SODIUM METASILICATE

Grades or Strengths: Granular, thru 10 mesh; Powdered, 90% thru 40 mesh
Packing: Multiwall Paper Bags, Fibre Drums

DISODIUM PHOSPHATE

Grades or Strengths: Anhydrous
Packing: Multiwall Paper Bags, Fibre Drums

SODIUM SULFATE, Anhydrous

Grades or Strengths: Standard, approximately 99.5% Na_2SO_4
Packing: Multiwall Paper Bags

TRISODIUM PHOSPHATE

Grades or Strengths: Coarse, thru 10 on 20 mesh; Medium, thru 20 mesh on 100 mesh; Standard, thru 20 mesh, 15-25% thru 100 mesh; Fines, thru 40 mesh, 50% thru 100 mesh; Flake.
Packing: Multiwall Paper Bags, Fibre Drums

TETRASODIUM PYROPHOSPHATE

Grades or Strengths: Anhydrous, Powdered, 100% thru 20 mesh, 90% min. thru 100 mesh
Packing: Multiwall Paper Bags, Fibre Drums

SODIUM TRIPOLYPHOSPHATE

Grades or Strengths: Anhydrous, Powdered, 90% thru 100 mesh; Granular, 95% thru 20 mesh
Packing: Multiwall Paper Bags, Fibre Drums

ACIDIZING

MURIATIC ACID (Hydrochloric)
HYDROFLUORIC ACID

MUD CONDITIONING

SODIUM SILICATE

Grades or Strengths: Clear and Opalescent Grades in a wide range of viscosities ranging from 38° to 60° Baume
Packing: Steel Drums, Tank Cars, Tank Trucks

DISODIUM PHOSPHATE
TRISODIUM PHOSPHATE
TETRASODIUM PYROPHOSPHATE (TSPP)
SODIUM TRIPOLYPHOSPHATE

OTHER CHEMICALS

Aluminum Sulfate, Standard & Iron Free
Aqua Ammonia
Cuprous Chloride
Nitric Acid
Potassium Nitrite
Sodium Fluoride
Other Heavy Chemicals

CATALYSTS and SPECIAL CHEMICALS

Companies requiring catalysts, addition agents, inhibitors, or other special chemicals "tailor-made" for their individual processes are invited to consult with General Chemical on their requirements. The same progressive research, technological "know how," and practical experience that has found the answer to so many petroleum chemical problems during General's long service to the Industry may help provide the solution to yours, too.

The products advertised herein are commercial chemicals having various uses, some of which may be covered by patents, and the user must accept full responsibility for compliance therewith.

BASIC CHEMICALS

FOR AMERICAN INDUSTRY

FOR THE LABORATORY OR SPECIAL APPLICATIONS: BAKER & ADAMSON REAGENTS and FINE CHEMICALS

GENERAL CHEMICAL DIVISION

ALLIED CHEMICAL & DYE CORPORATION

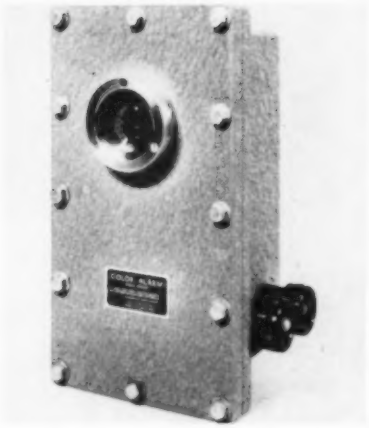
40 RECTOR STREET, NEW YORK 6, N. Y.

Offices: Albany • Atlanta • Baltimore • Birmingham • Boston • Bridgeport • Buffalo • Charlotte • Chicago Cleveland • Denver • Detroit • Greenville (Miss.) • Houston • Jacksonville • Kalamazoo • Los Angeles Minneapolis • New York • Philadelphia • Pittsburgh • Providence • San Francisco • Seattle • St. Louis Yakima, (Wash.)

In Wisconsin: General Chemical Company, Inc., Milwaukee

In Canada: The Nichols Chemical Company, Limited • Montreal • Toronto • Vancouver

[What's New in Equipment]



Color Alarm

Hallikainen Instruments' new Hallikainen-Shell Development Color Alarm is a differential type colorimeter which provides an alarm or a visual signal when a present color limit is exceeded. The company reports that the instrument has been used successfully in the petroleum field for control of kerosine color and has effected economy in eliminating the need for rerunning a tank of kerosine.

The instrument can be used also in other industries and can be adapted not only as an alarm, but also to indicate, record or control.

Circle No. 20 on Postcard

Transmission Systems

The pneumatic, magnetic, electric, electronic and electronic-follower transmission systems for use in measurement and control of flow, pressure, liquid level, viscosity and specific gravity are described in a new catalog published by Fischer & Porter Company.

Performance characteristics and schematic diagrams of the various systems are contained in the booklet.

Circle No. 21 on Postcard

Conveyor Belt Weighing System

A new conveyor belt weighing system capable of electronically adding, subtracting and recording the tons per hour of material delivered to one or more points has been jointly developed by Trans-Weigh Company and the Industrial Division of Minneapolis-Honeywell Regulator Company.

The belt system is applicable for belt-conveyed materials ranging from low-grade ore to refined sugar. It continuously weighs material being delivered and provides running measurements of tonnage as well as the total tonnage delivered over a period of time. These measurements can be transmitted over considerable distance. Chart records are also automatically maintained.

The new system is able to control the blending of several different materials on a belt, a common practice in some industries.

Circle No. 22 on Postcard

Acid-Resistant Teflon

The new bulletin issued by the packing division, Raybestos-Manhattan, Inc., features R/M teflon products, which include gaskets, rings in irregular shapes, sheets, tubes, rods, tape, braided and plastic packings, packings for stuffing boxes and valve stems.

According to the manufacturer, R/M teflon products are ideal for use against acids, solvents and alkalies, because neither industrial acids nor caustic will attack teflon.

Circle No. 23 on Postcard

Non-Skid Hammer Handles

Custanite Corporation has made available its recently developed Slipruf coating on all sizes of the company's safety hammers and hand drifts. Developed from a special formula, the coating provides a touch friction surface which is extremely durable, greaseproof and sweatproof..

According to the manufacturer, the coating provides strong traction between the hand of the user and the handle of the tool to diminish the chances of dangerous accidents.

Circle No. 24 on Postcard

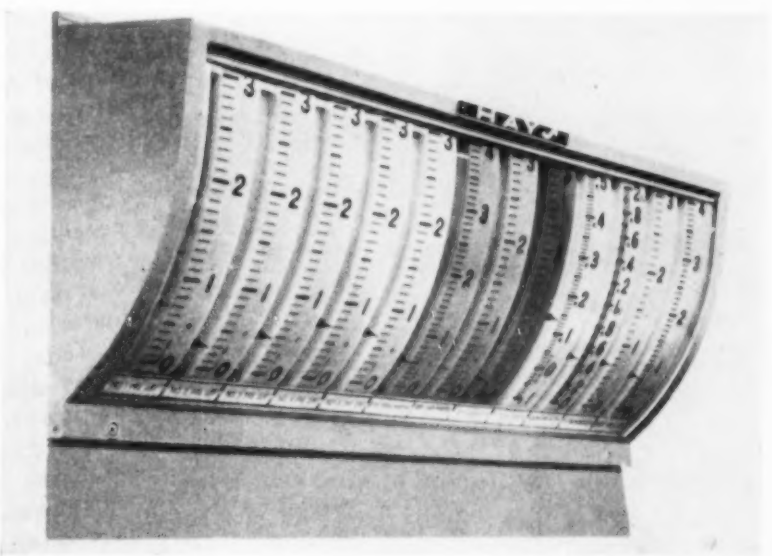
Spiral Nozzles

Bete Fog Nozzle, Inc., has just been issued a patent on its line of spiral fog nozzles. Higher efficiency combined with non-clogging performance are claimed for the new, improved nozzles.

As with earlier models, the spiral element shears a continuous film of liquid from a solid jet to form a fine fog of uniform drop size.

Forty-seven different models of spiral nozzles are now being manufactured by the Bete company. They range in flow rates from 1 to 1000 gallons per minute for fire protection, chemical processing, humidifying, washing, cooling, treating gases and many other industrial applications.

Circle No. 25 on Postcard



Streamlined Draft Gauge

The Hays Vertiscale is a new draft gauge which incorporates such features as a three-way atmospheric vent, easy "one man" zero check, large identification label space, magnetic access door and a dust tight case.

The basic operating mechanism of the gauge is a diaphragm, enclosed in a cast metal housing, the force and movement of which is balanced against the force of calibrating springs. The resultant force and movement of the diaphragm is transmitted through linkage to the pointer to indicate the magnitude of the draft, pressure or differential to which the diaphragm element it subjected.

The Hays Corporation has made the Vertiscale available in four types of mounting to meet special requirements of individual installations: a semi-flush mounting; a recessed mounting for above eye-level reading; an eye-level mounting and a projected or lug mounting.

The Vertiscale is described in a new bulletin, No. 52-1060-210, just published by Hays.

Circle No. 26 on Postcard

LAYNE WATER WELLS

. . . are part of BELL AIRCRAFT'S amazing growth

If you are interested in a water well installation, please write for more information about Layne services.

One of America's most interesting sagas of industry, is the amazing growth of Bell Aircraft Corporation's Helicopter Division at Hurst, Texas. From this great plant Bell "eggbeaters" have gone to all parts of the world—both for war and peacetime service.

When Bell Aircraft selected a site for their big Texas plant, they immediately ordered the installation of a complete Layne Water Supply System. Today that single Layne installation is more than fulfilling all water supply needs for both manufacturing and employees—and apparently can continue to do so for many years to come. Layne is happy to name Bell Aircraft Corporation as another in a long list of important industrial organizations that own Layne Water Wells and Pumps.

LAYNE & BOWLER, INC.
General Offices, Memphis 8, Tenn.

Layne

Without obligation Layne will be glad to provide a complete file of late catalogs and literature on modern water supply wells and high efficiency vertical turbine pumps.

WATER WELLS
VERTICAL TURBINE PUMPS
WATER TREATMENT

[What's New in Equipment]

Polyethylene Drum Liner

The use of mandrels, necessary with flat liners, is eliminated by a new polyethylene drum liner offered by Mehl Manufacturing Company, a division of the Sydney-Thomas Corporation.

Said to be easier to use because of a circular disc which forms the bottom, the liner also eliminates the creases that sometimes result in leaks and ruptures in the flat type bags. The bottom is formed by a fiber disc between two layers of polyethylene.

The liners range in gauge from .0015, often used with smaller drums and less corrosive products, to heavy .006, for use with highly corrosive products. They are available for use with drums ranging in capacity up to 55 gallons.

Circle No. 27 on Postcard

Contamination Detector

A new instrument for accurately measuring atmospheric concentration of the aromatic hydrocarbons—benzene, toluene, xylene—is described in Circular 757 from the scientific section of the National Paint, Varnish and Lacquer Association, Inc.

The bulletin describes the instrument as "a tool that could be used to good advantage in maintaining safe working conditions wherever there is any possibility of atmospheric contamination due to aromatic hydrocarbons."

The instrument is known as the MSA Aromatic Hydrocarbon Detector.

Circle No. 28 on Postcard

Non-Return Valve Description

Golden-Anderson Valve Specialty Company's cushioned single-acting non-return valve is described in a new bulletin made available by the company. A complete list of parts and detailed drawings of three different yoke assemblies on the elbow, angle and globe bodies are featured.

Adaptability, testing, construction, installation, sequence of operation, servicing and specifications of the valve are discussed.

Circle No. 29 on Postcard

Recorder Servicing Safety

A new automatic motor cut-out mercury switch developed by the Industrial Division of Minneapolis-Honeywell Regulator Company is designed to give faster, safer instrument servicing of strip chart Tel-O-Set recorders.

Utilization of the new "quick-disconnect' switch will automatically de-energize the live power line to the chart motor of the recorder when the chassis is withdrawn beyond the safety catch. There is no danger of accidentally shorting disconnected leads dangling against the instrument case.

The Tel-O-Set recorder with the "quick-disconnect" switch is said to be a practical solution to maintenance problems, particularly in installations where space-saving and convenience mean fewer man-hours spent in servicing equipment. It eliminates the need for explosion-proof switches; the necessity for shutting down an entire panel, or taping "hot" wires.

Circle No. 30 on Postcard

Close-Coupled Pump

Allis-Chalmers Manufacturing Company's new bulletin describes construction features of the company's supporting-adapter type, close-coupled general purpose pump in capacities to 2500 gpm. at heads to 550 feet.

Easy to install, compact and requiring a minimum of space, the pump is available in a choice of packing or mechanical seal, and in a choice of materials, according to the bulletin.

Circle No. 31 on Postcard

Multi-Purpose Grease

The unique multi-purpose properties of Shell Oil Company's alvania grease are attributed to the use of lithium 12-hydroxy stearate. One of the basic characteristics of this lithium base product is high resistance to breakdown. The company is now verifying the mechanical stability indicated when this grease withstood over a million strokes in an ASTM motorized worker test, without loss of body.

Other alvania properties combining to make multi-purpose application of this grease possible are: 1) its high water tolerance, 2) its broad temperature range, 3) its low rate of oxidation and long induction period and 4) its excellent storage stability.

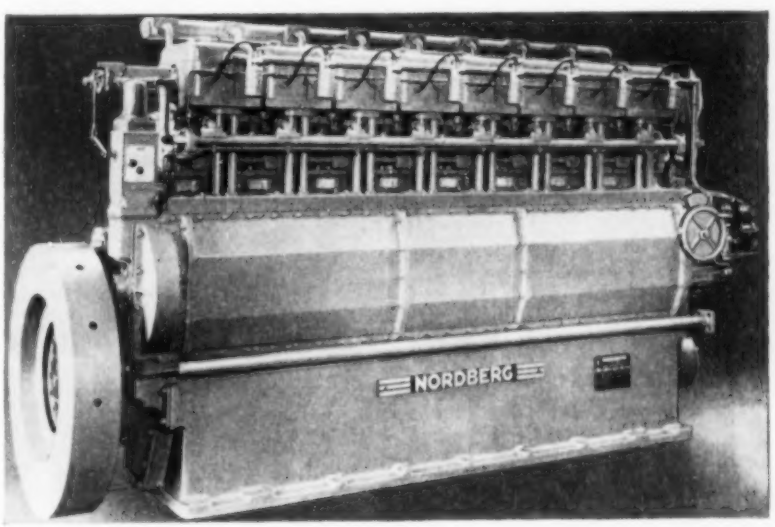
Circle No. 32 on Postcard

Insulation Specifications

Johns-Manville has issued a new brochure designed as a quick reference for engineers and others who must specify thermal insulations in the oil and chemical industries. Entitled "Johns-Manville Insulation Specifications for Oil Refineries and Chemical Process Plants," it contains specifications written for economy of operation, better control of process temperatures and for the safety of both personnel and equipment.

Described in the first part of the booklet is the complete insulation service offered by the company. This is followed by specifications for oil refinery and chemical process plant equipment requiring thermal insulation.

Circle No. 33 on Postcard



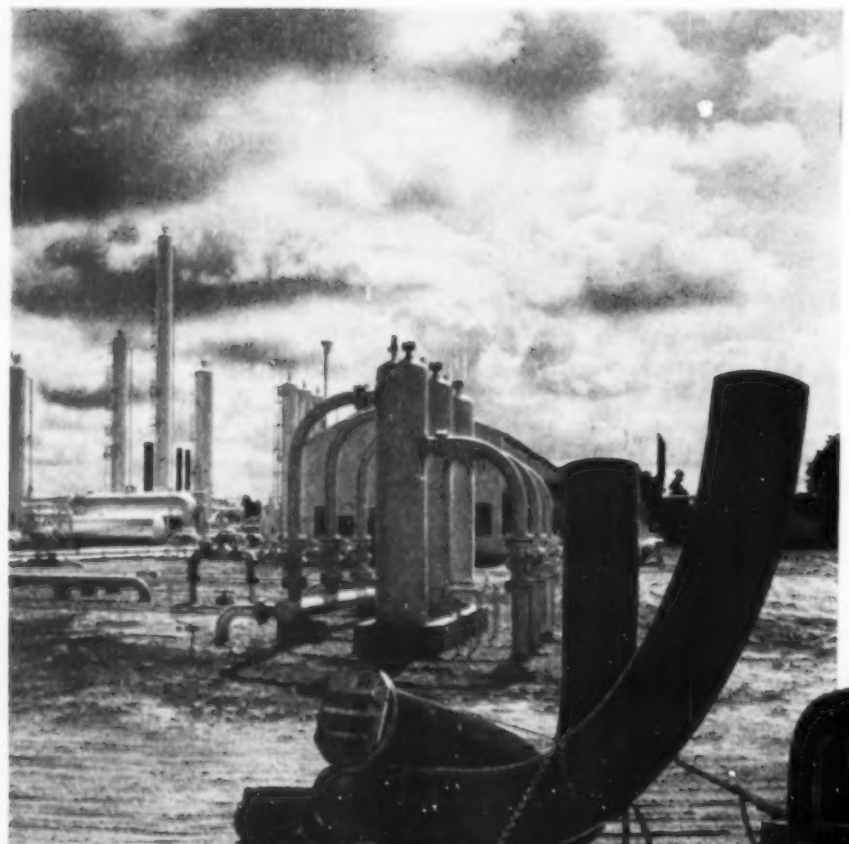
Spark-Fired Gas Engines

A series of four-cycle spark-fired gas engines, known as Types FSE-9 and FSE-13 is now being produced by Nordberg Manufacturing Company. With 9-inch and 13-inch bore sizes, respectively, in non-supercharged, supersupercharged, intercooled-supercharged and Supairthermal types covering a range of 265 to 4260 hp., the engines burn natural gas, butane, propane, manufactured gas and sewage gas. Other gases of lower Btu. content can also be used, but at reduced ratings.

The company lists the engines' high thermal efficiency as their outstanding operating advantage. This efficiency ranges in excess of 41 percent with the Supairthermal type engine to 38 percent with the non-supercharged engine. To assure smooth, uniform combustion, the correct air-fuel mixture is maintained by the precise timing of the inlet valve.

Circle No. 34 on Postcard

PIPE BENDS *Exactingly* ENGINEERED



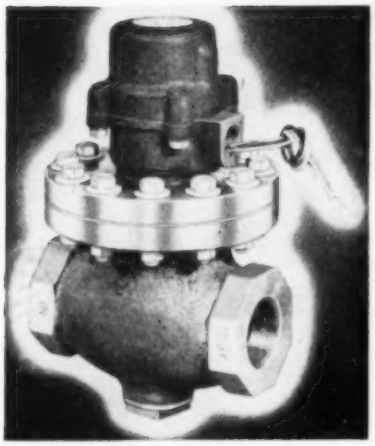
TEXAS PIPE BENDING COMPANY

PIPE BENDS
PIPE COILS
WELDED HEADERS

Pipe Fabricators
HOUSTON TEXAS
P. O. BOX 5188

OFFICE AND PLANT
301 FRIO STREET
WEntworth 6605

[What's New in Equipment]



Self-Tightening Valve

Velan Engineering Company has developed two new products which have been well received by users.

The Harper-Velan Self-Tightening Valve offers a combination seal and seat disc to overcome disadvantages of service found in present steel valves. This valve has an exclusive reversible seat and disc; the unused portion of the disc is held in reserve and protected against wear.

The Velan Rotodrain features an integral drainage control. Because of the features of this steam joint, users get many advantages such as: 1) the integral flow control is installed by a double window in the trap part of the Rotodrain; 2) for the first time, the syphon pipe arrangement can be taken out from the line without removing the joints from the cylinder; and 3) all parts of the Rotodrain can be taken apart in the line without removing the steam joint from the cylinder.

Circle No. 35 on Postcard

1953 Rust Preventives

Rust-Oleum Corporation's new 1953 General Catalog describes through illustrations and charts how Rust-Oleum stops rust. Featuring 73 color chips of Rust-Oleum products, the new catalog includes complete instructions for surface preparation and application of Rust-Oleum primers, short oil type, long oil type, machinery and implement finishes, chemical and heat resistant types, sealers, thinning oils, and floor and masonry coatings.

Circle No. 36 on Postcard

Flexible Quick-Opening Valve

McRae Corporation's new Sentry piston-operated quick-opening valve is designed for flexibility and speed of action. For use in emergency control systems in chemical and other industrial plants, the valve is particularly applicable in opening water into quench lines, in sprinkler, spray or fog systems, and in dumping process vessels to outside storage in times of plant fires.

Circle No. 37 on Postcard

Laboratory Aids

Scientific Glass Apparatus Company, Inc., has issued its sixteenth edition of "What's New for the Laboratory."

Included in the 27 featured items are: a high-speed projection type balance which can also be used for analytical work; a device for trapping mercury blown from manometers; a surface temperature thermometer; two-stage vacuum pump; microscope with built-in illuminator; non-corrosive optical cover glass; sulfur determinator; glass distillation apparatus for small scale operations; a number of polyethylene items and various other laboratory aids.

Free copies of this booklet are available.

Circle No. 38 on Postcard

Flow Characteristics

Information about head loss due to friction in Carlon Products Corporation's Carlon pipe is now available in the form of charts and graphs. These are based on a combination of Carlon's own experience and a compilation of data derived from a thorough check of flow properties by foremost hydraulic laboratories throughout the country.

Circle No. 39 on Postcard

Dissolved Oxygen Analyzer

Unlike the usual Winkler test for dissolved oxygen, Dorber Company's Dorber dissolved oxygen analyzer is not subject to interference by dissolved iron, calcium, magnesium or organic matter.

The instrument features rapid, accurate oxygen determinations in aqueous solutions. It is self-contained in a cabinet 22x11x7 inches and uses batteries which have almost shelf life.

The analyzer uses a amperometric principle in which minute traces of dissolved oxygen are reduced at a rotating platinum cathode. The rotating electrode assembly is built on a detachable frame and can be used for other analyses if desired.

Circle No. 40 on Postcard

Ethanolamines

A new bulletin on the ethanolamines—mono-,di-, and triethanolamine—has been released by Carbide and Carbon Chemicals Company. The booklet contains chemical, physical and psychological properties; shipping data; and applications in all branches of manufacturing and processing industries.

Circle No. 41 on Postcard

Process Equipment Booster

Otto H. York Company, Inc., has published a new 12-page catalog, No. 13, which describes how Yorkmesh Demisters improve the performance of liquid-vapor processing equipment.

The booklet describes the strong, flexible construction and operation of Yorkmesh Demisters, which can be installed without difficulty in existing or new process equipment to eliminate entrainment losses, to improve product quality or to make possible increased throughput rates.

Circle No. 42 on Postcard

Heavy-Duty Shovel-Crane

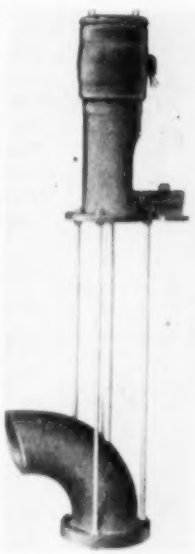
A new heavy-duty truck-mounted shovel-crane has been developed by Schield Bantam Company to provide 20 percent more lifting capacity than previous bantam models. Rated at six tons capacity, the new model has several improvements over previous bantams. Among them are: a stronger main frame with 54 percent increase in section modulus; larger shafts and bearings throughout; bigger diameter center pin; newly designed trunnion base with wider trunnion rollers and the use of four adjustable cam-type hook rollers instead of three.

The new, heavy-duty Model T-35 Bantam can be mounted on any new or used tandem axle truck having a wheelbase of 164 inches or more.

Circle No. 43 on Postcard

New Type Agitator

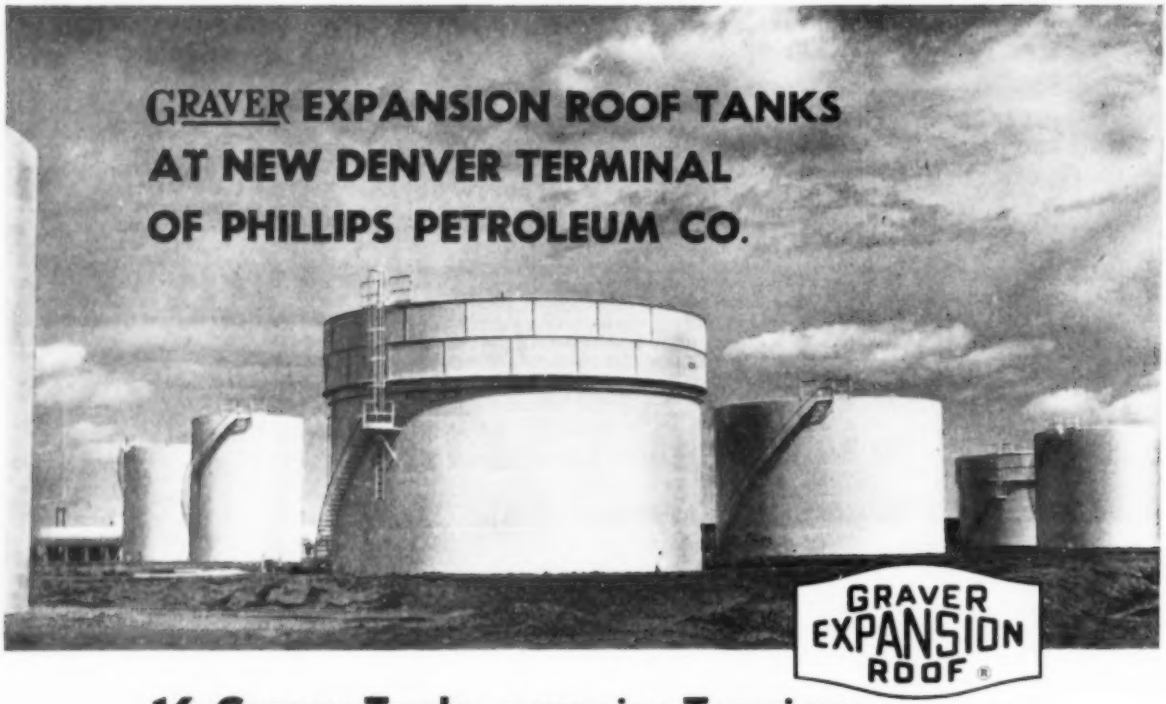
Chemineer, Inc., developed the turbotube agitator to meet the demand for a top-entering agitator which would have the hydraulic advantages of a side-entering unit. The company claims that physical disadvantages of conventional equipment, such as submerged stuffing box, costly installation and inaccessibility for maintenance, have been eliminated.



When installed the special draft bend is completely submerged in the mix. A high-speed marine type propeller produces positive flow up through and horizontally out of the bend.

The original function of the agitator was to give consistent and thorough agitation of long rectangular pickling tanks. It has other applications in fields where tank geometry does not allow optimum agitation with standard methods, or where a submerged stuffing box cannot be employed.

Circle No. 44 on Postcard



16 Graver Tanks comprise Terminus of new Phillips Pipeline

Graver supplied all the field-erected tankage for the Phillips Petroleum Company at its recently completed products pipeline terminal at Denver. The final step in a new 355 mile pipeline from the Texas Panhandle to the Rocky Mountain area, the terminal is equipped to handle the storage and distribution of such products as gasoline, aviation gasoline, L.P.G., kerosene and diesel fuels. The terminal receives approximately 5,000 bbls. of petroleum products each day.

A total of 16 Graver tanks are in service at the installation and have a total capacity in excess of 140,000 bbls. Conspicuous in this tankage are two 20,000 bbl. Graver Expansion Roof tanks, each equipped with a 10′ lift. Manifolded to these 60′ and 40′ tanks are a number of cone roof tanks, forming closed vapor systems. As the vapors from the volatile products stored within these cone roof tanks expand with increases in temperature, they travel through the vapor lines to the Expansion Roof tanks and the roofs rise to accommodate them. As the temperature drops, the vapors travel back to the cone roof tanks and the Expansion Roofs descend. As a result of the automatic action, all breathing losses are eliminated and filling losses minimized.

Thus, Graver Expansion Roof tanks are providing the key to the purpose of this new terminal—the delivery of a dependable year-round supply of refinery-fresh petroleum products to Phillips' customers throughout the Denver area.

GRAVER TANK & MFG. CO. INC.

EAST CHICAGO, INDIANA

NEW YORK • CHICAGO • PHILADELPHIA • WASHINGTON
DETROIT • CLEVELAND • PITTSBURGH
CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

New Equipment Literature

Copies may be obtained easily and without cost by using Reader Service Postcard. Just circle on the card the identifying key number of each item in which you are interested. Postcards are opposite page 160.

AIR PREHEATER—Details. The Air Preheater Corp. See page 86.
Circle A1 on postcard.

HARDFACING ALLOYS—Information. Air Reduction Magnolia Co. See page 35.
Circle A2 on postcard.

TUBE EXPANSION CONTROL SYSTEM—Information. Airetool Manufacturing Co. See page 177.
Circle A3 on postcard.

WATER CONDITIONING SERVICE—Information. Allis-Chalmers Manufacturing Co. See page 5.
Circle A4 on postcard.

EXLOSION-PROOF MOTORS—Bulletin 51B7149. Allis-Chalmers Manufacturing Co. See page 7.
Circle A5 on postcard.

ADDITIVE—Information. The Alox Corp. See page 218.
Circle A7 on postcard.

INSULATING MATERIALS—Information. Baldwin-Hill Co. See page 190.
Circle B5 on postcard.

SWING JOINTS—Catalog No. 400. Barco Manufacturing Co. See page 158.
Circle B6 on postcard.

CONTROLS—Catalog. Black, Sivalls & Bryson, Inc. See page 38.
Circle C1 on postcard.

STEEL GRATING—Bulletin 2365. Blaw-Knox Co. See page 205.
Circle C2 on postcard.

PIPE MARKERS—Samples and Catalog. W. H. Brady Co. See page 227.
Circle C3 on postcard.

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS—Catalog P1245. The Bristol Co. See page 36.
Circle C5 on postcard.

COLLECTION AND RECOVERY OF INDUSTRIAL DUSTS—Bulletin. Buell Engineering Co. See page 153.
Circle C7 on postcard.

GAS AND AIR LINE SNUBBERS—Data. Burgess-Manning Co. See page 32.
Circle C8 on postcard.

SEAL UNIONS—Data Sheet. Catawissa Valve & Fittings Co. See page 213.
Circle C9 on postcard.

CHECK VALVES—Catalog No. 30. The Chapman Valve Manufacturing Co. See page 34.
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CONDENSER AND HEAT EXCHANGER TUBES—Book. Chase Brass & Copper Co. See page 64.
Circle D2 on postcard.

SWIVEL JOINTS—Catalog 51-C. Chiksan Co. See page 208.
Circle D5 on postcard.

CENTRIFUGAL BLOWERS—Bulletin 0500. De Laval Steam Turbine Co. See page 17.
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GASOLINE DYES—Booklet. E. I. du Pont de Nemours & Co. See page 72.
Circle E5 on postcard.

WEED AND GRASS KILLER—Booklet. E. I. du Pont de Nemours & Co. See page 149.
Circle E6 on postcard.

CENTRIFUGAL CASTING—Catalog 3150. The Duraloy Co. See page 159.
Circle E8 on postcard.

STEAM TURBINES—Bulletin. Elliott Co. See page 18.
Circle E9 on postcard.

TUBE CLEANERS—Bulletin Y-29. Elliott Co. See page 145.
Circle F1 on postcard.

ELECTRIC TEMPERATURE CONTROL AND DETECTION DEVICES—Catalog. Fenwal Incorporated. See page 60.
Circle F2 on postcard.

EXPANSION JOINTS—Bulletin. Flexonics Corp. See page 62.
Circle F4 on postcard.

PIPING SERVICES AND FACILITIES—Literature. The Flori Pipe Co. See page 10.
Circle F5 on postcard.

ENGINEERING AND CONSTRUCTION FACILITIES—Information. The Fluor Corp. See page 19.
Circle F6 on postcard.

FLOW METERS—Bulletin 460. The Foxboro Co. See page opp. 193.
Circle G1 on postcard.

ENGINEERED ELECTRICAL SYSTEMS—Information. General Electric Co. See pages 172-173.
Circle G4 on postcard.

HEAT EXCHANGER—Bulletin. The Griscom-Russell Co. See page opp. 177.
Circle G7 on postcard.

CORROSION INHIBITOR—Information. D. W. Haering & Co. See page 196.
Circle G9 on postcard.

COOLING TOWER FANS—Bulletin 1501. Hartzell Propeller Fan Co. See page 228.
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COOLING EQUIPMENT—Bulletins. Hudson Engineering Corp. See Insert 64-65.
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STEAM JET ERECTORS—Bulletin 9013A. Ingersoll-Rand Co. See page 54.
Circle H3 on postcard.

MIXERS—Catalogs. International Engineering, Inc. See page 216.
Circle H4 on postcard.

NICKEL ALLOY TUBING—Information. The International Nickel Co. See page 58.
Circle H5 on postcard.

WIRE MESH PRODUCTS—Details. The C. O. Jelliff Mfg., Co. See page 211.
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PIPE GASKETS—Catalog PK-35A. Johns-Manville Corp. See page 56.
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HEAT INSULATION MATERIAL—Book. Kaylo Division, Owens-Illinois Glass Co. See page 30.
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ASBESTOS-CEMENT SHEETS—Information. Keasbey & Mattison Co. See page 185.
Circle H9 on postcard.

LIQUID PUMPS—Bulletin L-51. Kinney Manufacturing Co. See page 214.
Circle J2 on postcard.

STEEL GRATING AND STAIR TREADS—Catalog. Klemp Metal Grating Corp. See page 37.
Circle J3 on postcard.

WATER WELL INSTALLATIONS—Information and Catalogs. Layne & Bowler, Inc. See page 164.
Circle J6 on postcard.

ELECTRONIC CONTROLLERS, RECORDERS AND INDICATORS—Literature. Leeds & Northrup Co. See page 8.
Circle J7 on postcard.

CALIBRATING TANKS—Bulletin CT-102. Warner Lewis Co. See page 205.
Circle J8 on postcard.

SAFETY RELIEF VALVES—Information. Manning, Maxwell & Moore, Inc. See page 52.
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AIR COOLED HEAT EXCHANGERS—Brochure. The Marley Co. See page 48.
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OIL HANDLING EQUIPMENT—Catalog. A. Y. McDonald Mfg., Co. See IV Cover.
Circle K5 on postcard.

PROCESS CONTROL INSTRUMENTS—Information. Mine Safety Appliances Co. See page 189.
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CONTROL VALVES—Bulletin 700-2. Minneapolis-Honeywell Regulator Co. See page 55.
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MIXERS—Catalogs. Mixing Equipment Co. See page 70.
Circle K9 on postcard.

MAGNESIA HEAT INSULATION—Data Manual. Mundet Cork Corp. See page 156.
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STEAM TURBINES—Information. Murray Iron Works Co. See page 202.
Circle L2 on postcard.

DUAL STAGE OIL BURNERS—Bulletin 25. National Airoil Burner Co. See page 219.
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PILOT REGULATORS—Bulletin No. 614. Natural Gas Equipment, Inc. See page 207.
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STEAM TRAPS—Catalog 751. W. H. Nicholson & Co. See page 26.
Circle L5 on postcard.

PAINT, DIRT AND GREASE STRIPPERS—Booklet F7629. Oakite Products, Inc. See page 190.
Circle L6 on postcard.

RETURN BENDS—Pamphlets. The Ohio Steel Foundry Co. See page 186.
Circle L7 on postcard.

TUBING—Bulletin. Pacific Tube Co. See page 157.
Circle L9 on postcard.

DIAL THERMOMETERS—Bulletin 51-129. Palmer Thermometers, Inc. See page 210.
Circle M2 on postcard.

TRANSPARENT GAGES, EJECTORS AND CYCLING JET PUMPS—Catalog 35; Bulletin 512 and 5030. Penberthy Injector Co. See page 47.
Circle M4 on postcard.

FLEXIBLE TUBING—Folder. Pennsylvania Flexible Metallic Tubing Co. See page 22.
Circle M5 on postcard.

PROCESS INSTALLATIONS AND ENGINEERING SERVICE—Information. Perco Division, Phillips Petroleum Co. See page 20.
Circle M6 on postcard.

ELECTRIC DESALTING PROCESS—Information. Petrolite Corp. See page 183.
Circle M8 on postcard.

HEATING AND COOLING PROCESS COILS—Bulletin P78. Platecoil Division, Kold-Hold Manufacturing Co. See page 197.
Circle M9 on postcard.

PROCESSING AND HEAT TREATING EQUIPMENT—Catalog 52. The Pressed Steel Co. See page 33.
Circle N2 on postcard.

AIR FOAM EQUIPMENT—Information. Pyrene Manufacturing Co. See page 154.
Circle N3 on postcard.

PIPE STANCHIONS—Literature. The George Rackle & Sons Co. See page 211.
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BAR STOCK VALVES—Information. Reading-Pratt & Cady Division. See page 191.
Circle N5 on postcard.

BUBBLE TRAYS—Information. Republic Steel Corp. See page 187.
Circle N7 on postcard.

CONDENSER TUBES AND PLATES—Booklet. Revere Copper and Brass, Inc. See page 143.
Circle N8 on postcard.

DIAL THERMOMETERS—Details. Rochester Manufacturing Co. See page 220.
Circle P1 on postcard.

LUBRICATED PLUG VALVE—Bulletin V-217. Rockwell Manufacturing Co. See pages 28-29.
Circle P2 on postcard.

BALL VALVES—Bulletin. Rockwood Sprinkler Co. See page 39.
Circle P3 on postcard.

GAS AND AIR HANDLING EQUIPMENT—Bulletins. Roots-Connersville Blower Corp. See page 69.
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TEMPERATURE REGULATORS—Catalog 600-14. Sarco Company, Inc. See page 49.
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PUMP VALVES—Catalog. Sims Pump Valve Co., Inc. See page 212.
Circle P7 on postcard.

PETROLEUM SULFONATES—Booklet. L. Sonneborn Sons, Inc. See page 188.
Circle P8 on postcard.

LIQUID AGITATORS AND PRESSURE VESSELS—Booklet No. 58W. Struthers Wells Corp. See page 217.
Circle Q7 on postcard.

SOLID-WHEEL AND MULTI-STATE TURBINES—Bulletins No. S-116 and S-146. The Terry Steam Turbine Co. See page 50.
Circle Q9 on postcard.

TEMPERATURE CONTROLLERS—Bulletins. Thermo Electric Co., Inc. See page 40.
Circle Q7 on postcard.

PRIMERS—Catalog 50. Tnemec Company, Inc. See page opp. 176.
Circle Q9 on postcard.

RADIOACTIVITY APPLICATIONS—Pamphlet. Tracerlab, Inc. See page 192.
Circle R1 on postcard.

V-RINGS, PUMP PACKING AND GASKETS—Catalogs No. 810-V, 711 and I-339 WA. United States Gasket Co. See page 176.
Circle R2 on postcard.

HIGH SURFACE SODIUM—Booklet. U. S. Industrial Chemicals Co. See page 175.
Circle R3 on postcard.

CALCIUM-ALUMINATE CEMENT—Information. Universal Atlas Cement Co. See page 16.
Circle R6 on postcard.

SHELL AND TUBE HEAT EXCHANGERS—Bulletin He-6. Henry Vogt Machine Co. See page 24.
Circle R7 on postcard.

PROCESS VALVES—Bulletin 698. W-K-M Company. See page 82.
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IRON VALVES AND PIPE FITTINGS—Information. Walworth Company. See page 63.
Circle S2 on postcard.

TUBE EXPANDERS—Bulletin 68. The Gustav Wiedeke Co. See page 200.
Circle S5 on postcard.

STEAM TURBINES—Bulletin 1966. Worthington Corp. See page 11.
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DEMISTERS—Catalog 13. Otto H. York Co., Inc. See page 66.
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EXPANSION JOINTS—Bulletin 351. Zallea Brothers. See page 46.
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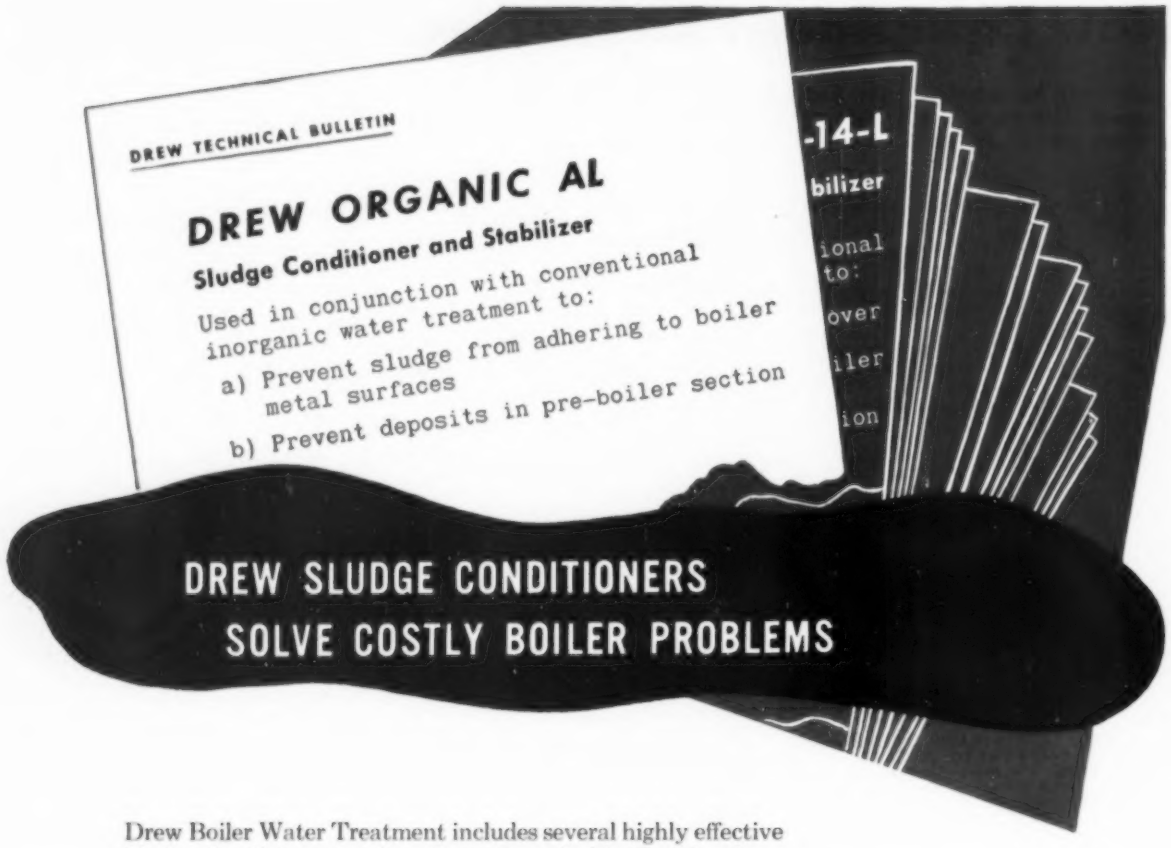

DREW SLUDGE CONDITIONERS SOLVE COSTLY BOILER PROBLEMS

Drew Boiler Water Treatment includes several highly effective Sludge Conditioners such as Drew Organic AL. Each has been developed to correct specific conditions in industrial water systems.

One major southeastern manufacturer was having difficulty with sludge and scaling in 13 boilers in 5 plants. Drew recommended a treatment of alkali, phosphate and Drew Sludge Conditioner AL. The entire system was cleaned up quickly and there has been no further trouble, costly maintenance or parts replacements.

To prevent or eliminate industrial water problems in your plant, you'll get results faster and more economically with this Drew program:

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5. Service by qualified field engineers.
6. Technical assistance by the Drew Technical Department

Write for booklet "Complete Boiler Water Conditioning" and technical bulletins.

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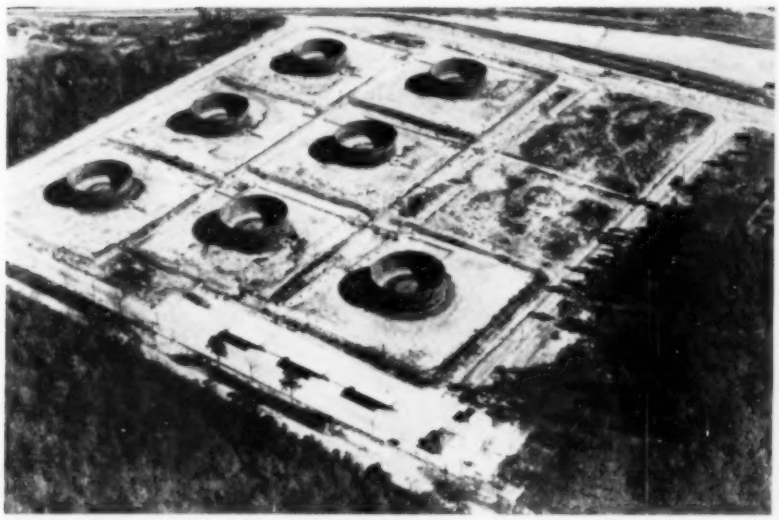
[What's Happening in the Industry]



Bulk Storage Plant Accepted—

The Air Material Command has formally accepted the $2,341,000 petroleum bulk storage facility at North Charleston, S. C., and placed it into operation. This storage depot for airplane gasoline and jet fuel has a total capacity of 23,500,000 gallons. Pipe lines will carry the fuel 2½ miles from incoming tankers to the Bulk Storage Facility. The overground pipe line is supported by concrete piers and timber piles. Salt water will be pumped through the lines from dock side to purge them whenever there is a change in the type of fuel. All fuel arriving at the storage depot will be filtered before going through the booster pumps to the tanks, and all fuel leaving the tanks will pass through separators to remove any water resulting from condensation. Racks are alongside for tank trucks and railroad tank cars.

Synthetic Fuels Program Gets Kind Words From Report, McKay

The synthetic liquid fuels research and development work carried on by the Bureau of Mines has received favorable words from President Truman's Council of Economic Advisers. The Council asserted it has paved the way for private investment.

Transmitted to Congress by the President, the Council's report cited the synthetics program as an example of "many government measures which may be taken to encourage private investment and which do not add much if anything to government expenditures."

"Technical and economic research in synthetic liquid fuels has reached a point where private investors are now actively interested in the establishment of synthetic liquid fuels," the report said.

The synthetic fuels program got yet another boost when incoming Interior Secretary McKay went on record as being "very strongly for" an experimental program with coal, gas and shale to develop synthetic fuels. His attitude on the subject was recorded on the transcript of the closed Senate Interior Committee hearing on McKay's nomination. The transcript shows that the new secretary's views were sought by the committee.

In reply to an observation by Senator Anderson (D., N. Mex.) that the "natural gas price is going to get so high that it will compel the development of coal areas," McKay said that his business in Oregon burned crude oil and that he used diesel oil in his home and that "it is getting expensive."

"All our industries in the Northwest would be vastly improved with gas," he said, adding that he has been told "there is no possibility of a gas shortage for some time."

Senator Millikin (R., Colo.) asked if he had any objection to the continuance of the government's experimental program with coal, gas and shale to develop synthetic fuel.

"Oh," McKay answered, "I am very strongly for it, Senator. I think we have to develop anything we can in the way of fuel these days, because we don't know when we will be at the end of our rope."

Sinclair Representatives Hold Three-Day Houston Symposium

Representatives from Sinclair Oil Corporation's New York office, its East Chicago, Ind., Marcus Hook, Pa., and Wellsville, N. Y., refineries gathered in Houston last month for a three-day symposium.

Among the subjects discussed were problems in cost accounting, methods of blending and compounding petroleum products, storage of packaged products and equipment for handling packaged products within the refinery, and oil drum reconditioning costs.

Gas Technology Course Set

Texas College of Arts and Industries, Kingsville, Texas, will hold its Eighth Annual Short Course in Gas Technology on May 27-29 this year on the school's campus.

Nine 1953 Board Committees Appointed by API Chairman

L. S. Wescoat, chairman of the board of directors of the American Petroleum Institute, has appointed nine board committees for 1953. Committees and appointed chairmen were:

Agricultural Advisory Committee, Sidney A. Swensrud, Gulf Oil Corporation; Automotive Safety Foundation Conference Committee, L. S. Wescoat, The Pure Oil Company; President's Advisory Committee on Interdivisional Standardization, John R. Suman, Standard Oil Company (New Jersey); President's Advisory Committee on International Affairs, B. Brewster Jennings, Socony-Vacuum Oil Company, Inc.; Committee on National Oil Policy, A. Jacobsen, Amerada Petroleum Corporation; Program and Budget Review Committee, Robert H. Colley, The Atlantic Refining Company; Public Relations Committee, H. S. M. Burns, Shell Oil Company; Safety Committee, N. C. McGowen, United Gas Pipe Line Company; Research Committee, Robert E. Wilson, Standard Oil Company (Indiana).

API's Lubrication Committee Ready for First 1953 Meeting

Five top-flight speakers are on the program of the first 1953 meeting of the Lubrication Committee of American Petroleum Institute's Division of Marketing. The meeting is scheduled for February 16-18 at Detroit's Sheraton-Cadillac Hotel.

Speakers who will address the group session on Tuesday, February 17, and their topics are:

Earl Bartholomew, Ethyl Corporation, Detroit, "25 Years of Crankcase Oil Performance;" H. W. Luetkemeyer, Cleveland Graphite Bronze Company, Cleveland, "Analysis of Bearing Failures;" T. C. Gleason, Chrysler Corporation, Detroit, "Engine Oil Fed Torque Converter;" Dr. W. S. James, Fram Corporation, Providence, R. I., "The Oil Filter Grows Up."

Bureau of Mines And PAD Make Forecasts For 1953 Oil Demand

The Bureau of Mines was first when it forecast that the total demand for all oils in 1953 would average 8 million barrels a day, an increase of 3.8 percent over estimated 1952 demand of 7.7 million barrels a day.

About a week later Petroleum Administration for Defense advanced its own forecast that the 1953 total demand would average 8,031,000 barrels a day in 1953, an increase of 4.2 percent over 1952.

Included in the Bureau's figures are exports averaging 354,000 barrels a day (drop of 16 percent) and the domestic demand averaging 7,646,000 barrels a day (rise of 4.9 percent). PAD foresaw the domestic demand alone climbing to 7,693,000 barrels a day (rise of 5.7 percent).

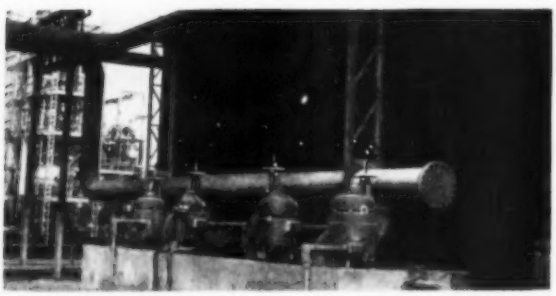
Both agencies felt only a slight increase in supply for 1953 was needed. PAD's average industry crude runs needed to meet estimated 1953 demand

ENGINEERING REPORTS:

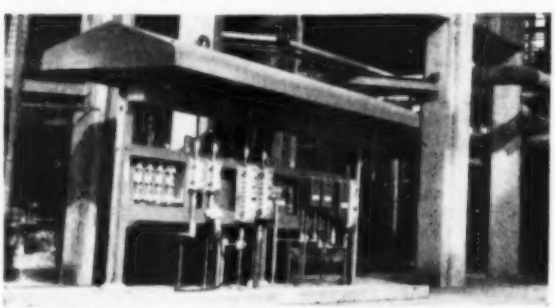
INCOMING POWER is controlled by this G-E metal-clad switchgear. Providing primary-circuit protection, these compact G-E units are factory-assembled to speed installation, metal-enclosed to provide maximum safety to personnel.

Refinery's power system helps

PLANT POWER FACTOR is improved by 360-kvar G-E capacitor equipment near a refinery-type load-center substation.



COOLING-WATER PUMPS, in non-hazardous location, are driven by four G-E vertical motors rated 150 hp, 440 volts.

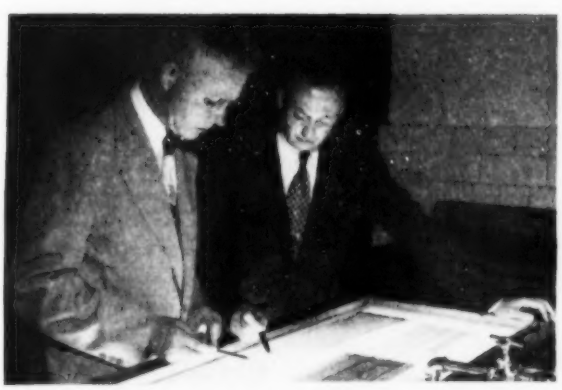


IN HAZARDOUS LOCATION near catalytic cracking tower, explosion-proof enclosures help protect G-E motor starters.

HIGH VOLTAGE POWER is brought economically to load centers and stepped down at unit substations like this one, rated 1000 kva.

Racked-up G-E explosion-proof equipment includes manually operated master breaker and magnetic starters for plant motors.

maintain high-output continuity



G-E ENGINEERING uses modern facilities in designing improved equipment to give you greater continuity of power service. These engineers at the new G-E Switchgear Development Laboratory examine films of a typical switchgear test.

G-E engineered distribution system helps keep Phillips Petroleum Co., Phillips, Texas plant refining 80,000 bbl/day

In its refinery at Phillips near Borger, Texas, the Phillips Petroleum Company cracks and blends petroleum products at the rate of 80,000 barrels per day. Helping to maintain this output on a continuous basis is the plant's power distribution and drive equipment, co-ordinated by Phillips' and General Electric engineers to meet the plant's specific processing needs.

Here is one more in a long list of petroleum refineries that have profited by G-E engineering experience. Whatever *your* refinery's electrical needs, General Electric application engineers can help you or your consultants co-ordinate your electric equipment for maximum efficiency. For more information, contact your nearest G-E Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y. 661-37

Engineered Electrical Systems for Petroleum Refineries

GENERAL ELECTRIC

is 6,925,000 barrels a day, which would be a modest increase of 260,000 barrels a day over the average crude runs for 1952.

Here is how the PAD forecast compared with the Bureau of Mines on several points:

	PAD	B of M
	(thousands of barrels)	
Exports	338	353
Imports	1,020	1,038
Total production	7,046	6,962
Stock change	35	(none)
Total Supply	8,066	8,000
Crude runs	6,925	6,863

Leach and Long Take Top Posts In Texas Company Changes

J. S. Leach, president of The Texas Company, has been named by the company's board of directors to succeed W. S. S. Rodgers as chairman of the board and chief executive officer of the company.

Long

Leach

Rodgers and Colonel Harry T. Klein, chairman of the executive committee, will retire from the company on March 1 and April 1, respectively, in accordance with the company's compulsory retirement plan. They will remain as members of the company's board of directors and executive committee.

A. C. Long, executive vice president, succeeds Leach as president.

It was in 1916 that Leach began his business career in the sales department of The Texas Company. He was elected a vice president in 1938, executive vice president in 1950 and president in April, 1952.

Long became associated with the company in 1930 and has served in both foreign and domestic operations of the company and its affiliates. He became vice president in charge of foreign operations, eastern hemisphere, in 1949, and executive vice president in January, 1951.

Rodgers, president from 1933 until his election as chairman of the board in 1944, has been with the Texas organization more than 37 years. Colonel Klein, associated with the company for 32 years, was general counsel from 1925 to 1944, and president until his election as chairman of the executive committee in 1952.

In another Texas Company change, J. W. Foley, assistant to the chairman of the board, has been elected a vice president. He will continue to serve in his old capacity.

Foley started with Texas in June, 1932, as a rotary rig helper. A year later he became a petroleum engineer. He has since acquired experience in both domestic and foreign oil operations.

Gulf Research & Development Divides Engineering Division

Two new divisions—engineering and automotive engineering—have been carved out of the engineering division of Gulf Research & Development Company, the research organization of Gulf Oil Corporation.

E. Topanelian, Jr., who joined Gulf Research in 1939 as an engineer and who later served as assistant director of the engineering division, has been appointed director of engineering. Bruce R. Walsh, who became an engineer in the Gulf Research organization in 1933, is the new assistant director of engineering.

J. Edward Taylor, formerly a member of the product development and product engineering department of the Gulf companies, has been transferred to the research department as director of automotive engineering. Charles R. Butler and R. L. Kirkpatrick are assistants to the director.

Prioleau Named Stanvac Head Following Parker Retirement

Horry F. Prioleau has been named president and chief executive officer of Standard-Vacuum Oil Company succeeding Philo W. Parker, who has retired after more than 40 years in the international petroleum industry.

Simultaneously A. W. Bourne, Jr., has retired as vice president and director, and C. B. Marshall has been made vice chairman of the company's executive committee. The two retirements reduce the board's membership to nine.

A vice president of Standard-Vacuum since 1949, Prioleau served as senior vice president and director of Creole Petroleum Corporation from 1941 to 1949.

Parker, an officer and director of Standard-Vacuum continuously since its formation in 1933, has been the company's chief executive officer for the past six years.

Bourne has been a Stanvac director since 1947, a vice president for nearly three years. He began his career as a marketer in Java 37 years ago.

Marshall has been a member of the company's board of directors since 1949 and a vice president since last June.

New Attorney General Pledges Review of "Cartel" Proceedings

Incoming Attorney General Herbert Brownell has promised that the Department of Justice will press all antitrust cases now in courts and will make a "thorough study" of other investigations, including the grand jury probe of the alleged "international oil cartel."

His oil case comments were drawn out during a meeting of the Senate Judiciary Committee, which approved Brownell's nomination unanimously.

Kidde Constructors Appoint Knowles to Top Executive Post

Charles W. Knowles has been appointed senior vice president of Walter Kidde Constructors, Inc. The former vice president and general superintendent has been with the company for 27 years and succeeds Walter S. Wainwright, retired.

Harold A. Cartier, formerly secretary, has been named vice president of the Kidde organization.

WHO'S MEETING

FEB. 1953	
16–18	American Petroleum Institute (Division of Marketing, Lubricating Committee Meeting), Sheraton-Cadillac, Detroit.
27	Natural Gasoline Assn. of America (Regional Meeting), Scharbauer Hotel, Midland, Texas.
MAR.	
2– 6	American Society for Testing Materials (Spring Meeting), Hotel Statler, Detroit.
8–11	American Inst. of Chemical Engineers, The Buena Vista, Biloxi, Miss.
15–19	American Chemical Society (123rd National Meeting), Hotels Biltmore and Statler, Los Angeles.
15–19	American Institute of Mining and Metallurgical Engineers (Annual Joint Meeting of Petroleum, Metals and Mining Branches), Statler Hotel, Los Angeles.
16–20	National Assn. of Corrosion Engineers, (1953 Conference and Exhibition), Hotel Sherman, Chicago.
23–25	Western Petroleum Refiners Association (Annual Meeting), Plaza Hotel, San Antonio, Texas.
25–27	Society of Automotive Engineers, (National Production Meeting), Hotel Statler, Cleveland Ohio.
APR.	
13–15	American Society of Lubrication Engineers (Annual Meeting and Exhibit), Hotel Statler, Boston, Mass.
13–15	Canadian Inst. of Mining and Metallurgy (Annual General Meeting), Hotel Fontenelle, Omaha, Nebr.
15–17	National Petroleum Association (Semi-Annual Meeting), The Macdonald, Edmonton, Alta., Canada.
21–23	Southwestern Gas Measurement (Short Course), University of Oklahoma, Norman, Okla.
22–24	American Institute of Electrical Engineers (Southern District No. 4), Louisville, Ky.
24–25	Interstate Oil Compact Commission (Spring Meeting), Roosevelt Hotel, New Orleans, La.
26–29	American Inst. of Chemical Engineers (Joint Meeting with Chemical Inst. of Canada), Royal York Hotel, Toronto, Canada.
27–28	Independent Petroleum Assn. of America (Midyear Meeting), Jefferson Hotel, St. Louis, Mo
29 to May 1	Natural Gasoline Association of America (Annual Convention), Rice Hotel, Houston.
MAY	
4– 5	American Petroleum Institute (Division of Marketing, Midyear Meeting), Baker Hotel, Dallas.
4– 6	Liquefied Petroleum Gas Assn. (Annual Convention and Trade Show), Conrad Hilton, Chicago.
4– 6	Eighth Purdue Industrial Waste Conference, Purdue Memorial Union Building, Lafayette, Ind.
5– 6	Gas Hydrate Control Conference Univ. of Oklahoma, Norman.
11–14	American Petroleum Institute (Division of Refining, 18th Midyear Meeting), Hotel Commodore, New York.
11–15	National Fire Protection Association (Annual Meeting), Edgewater Beach Hotel, Chicago.
27–29	Short Course In Gas Technology (Eighth Annual), Texas College of Arts and Industries, Kingsville, Texas.
28–29	Western Petroleum Refiners Association (Regional Meeting), Broadview Hotel, Wichita, Kans.

McKetta New Chairman Elect South Texas AIChE Group

Dr. John J. McKetta, Jr., editorial director of PETROLEUM REFINER, has been named chairman-elect and Dr. W. B. Franklin, Humble Oil & Refining Company, chairman of the South Texas Section of the American Institute of Chemical Engineers. Other officers include N. H. McKay, Shell Chemical Company, secretary; Dr. G. T. McBride, Rice Institute, treasurer; and the following exec-

NOW! ANOTHER

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SODIUM

High Surface Sodium

ON INERT SOLIDS

Just how reactive do you want your Sodium to be? If you want it at its maximum energy level, in an easily-handled, easily-controlled form, your answer is High Surface Sodium (HSS) on Inert Solids!

Using simple, easy-to-follow techniques, our researchers have applied atomic layers of Metallic Sodium to inert solids such as salt, soda ash, carbon, alumina and sand. HSS is free-flowing over a wide temperature range and has a large surface-to-weight ratio of Sodium. Reactions can be carried out in seconds instead of hours. The high surface area of Sodium in HSS, available for immediate reaction, is the key to its importance to industry.

HSS provides, through the complete and rapid reaction of Sodium, the following advantages:

- ¶ Easy control of reaction rates and temperatures above and below the melting point of Sodium
- ¶ Simple adaptation to continuous operations
- ¶ Dry-way reactions of Sodium
- ¶ Greater safety by eliminating flammable solvents
- ¶ High yields
- ¶ Preparation of products in finely divided and reactive states
- ¶ Means of avoiding induction periods

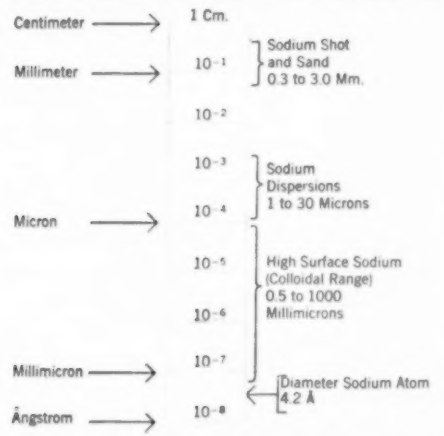
USES FOR HSS

1. Purification of gases, hydrocarbons and ethers (to remove oxygen, nitrogen, halogen and sulfur compounds, moisture and certain trace amounts of other impurities).
2. Preparation of Sodium Hydride and Sodamide for **in situ** use.
3. Reduction of Metal Salts and Oxides to finely divided metals, e.g., Zn, Fe, Pb, Cu, Ti, Ni, Pt, etc.
4. Catalyst for hydrocarbon cracking, polymerizations and rearrangement reactions.

APPARENT FILM THICKNESS VS. % Na IN HSS

% Na	Film Thickness on Alumina (Area— 160 $M^2/g.$)	Film Thickness on Colloidal Carbon (Area— 750 $M^2/g.$)
5%	1 Atomic Layer	<1 Atomic Layer
15%	Av. 2.5 Atoms Thick	<1 Atomic Layer
25%	Av. 5 Atoms Thick	Av. 1 Atom Thick

SODIUM PARTICLE SIZE AND FILM COMPARISONS



Particle size for Sodium Dispersions and HSS can be controlled within narrow ranges.

Send for our interesting new booklet — HIGH SURFACE SODIUM — which gives the complete story on this important development in Sodium chemistry.

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120 Broadway, New York 5, N. Y.
I'm interested in HSS. Please send your new booklet.

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NOTE: We do not produce HIGH SURFACE SODIUM. Our product is Metallic Sodium from 1 lb. bricks to tank car quantities. However, our technical staff can demonstrate the simplicity of preparing and utilizing HSS in your own plant in available equipment.

U.S.I.

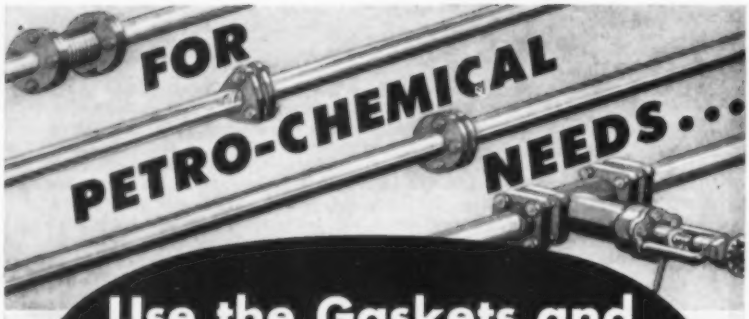
Metallic Sodium is manufactured by **National Distillers Chemical Co** at Ashtabula, Ohio and sold by:

U.S.I. INDUSTRIAL CHEMICALS CO.

Divisions of National Distillers Products Corporation

120 Broadway, New York 5, New York ***Branches in all principal cities.***

NATIONAL DISTILLERS CHEMICAL CO.



Use the Gaskets and Packing No Chemicals Can Attack

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CHEMISEAL V-RINGS

Select Chemiseal No. 810-V packing for valves. It provides necessary seal at low gland pressures and reduces valve torque because it is extremely anti-hesive. No lubricant is required for superior operation. Supplied in sets to meet specific requirements. Ask for Catalog No. 810-V.

CHEMISEAL PUMP PACKING

Select Chemiseal No. 711 packing for rotating or reciprocating shafts. It provides a low friction 2-way seal that not only prevents axial seepage, but also seals against shaft and stuffing box as well. Write for Catalog No. 711.

CHEMISEAL TEFLON-JACKETED GASKETS

Select Chemiseal No. 1-339 WA Teflon Jacketed Gaskets for all types of metal and special chemical resistant piping connections. Available in any size with a variety of filler materials suitable for stainless steel, glass, glass-lined steel, porcelain, Karbate, Haveg or other chemical piping and equipment. These fillers are protected on both faces and the inside diameter by the chemical resistant Teflon Jacket. Write for Catalog No. 1-339 WA.

UNITED STATES GASKET COMPANY

FLUOROCARBON PRODUCTS DIVISION
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Representatives in Principal Cities Throughout the World

[What's Happening]

utive committeemen: William L. Bolles, Monsanto Chemical Company; William Schambra, The Dow Chemical Company; D. A. Smith, Humble; and M. Van Winkle, University of Texas.

California Research Board Elects Two to Executive Posts

Election of A. L. Lyman to the newly established position of executive vice president and A. H. Batchelder to vice

Lyman Batchelder

president and director has been announced by the board of directors of California Research Corporation. Batchelder will also be general manager of the Cal Research laboratories at Richmond, Calif.

Lyman, who has been director of laboratories for this Standard Oil Company of California subsidiary since 1946, joined Standard in 1924 and when Cal Research was formed in 1944, he was made a director.

With Standard since 1930, Batchelder has been assistant director of the laboratories at Richmond since 1946.

Standard (Indiana) Promotes Five at Whiting Laboratory

In research department appointments at the Whiting, Ind., laboratory of Standard Oil Company (Indiana), R. V. Shankland has been promoted to senior research associate, and G. M. Webb has succeeded him as section leader on catalyst research and development. In the analytical research division, H. M. Grubb has been promoted to section leader, and C. H. Ehrhardt and R. R. Hopkins, to group leaders.

Dr. Shankland joined Standard in 1930 as a chemist, was advanced to group leader in 1938, and to section leader on catalyst research and development in 1948. Dr. Webb went to the company in 1948 as a research associate.

Dr. Grubb, a group leader since 1947, joined the company in 1938. Dr. Ehrhardt joined Standard as a senior project chemist in 1949, the same year that Dr. Hopkins joined the company.

Kenney Named to APIC Post to Fill Vacancy Left by Gentry

William F. Kenney, who succeeded Cyrus S. Gentry as vice president and general counsel of Shell Oil Company January 1, has been appointed a member of the American Petroleum Industries Committee. He fills the committee vacancy created by Gentry's retirement.

APIC is concerned with governmental

TNEMEC PRIMERS KILL RUST!

THE first step in preserving steel with paint is applying the prime coat. Its primary job is to prevent and kill rust action. TNEMEC Primers do just that, by creating a neutral condition on steel surfaces, changing active rust and corrosive agents into an inactive neutral compound.

The second step is applying the finish coat that will provide protection against the specific exposure hazards involved.

WHAT IS YOUR EXPOSURE HAZARD?

Is it the humid, salt-air atmosphere of coastal areas? Is it the acid-laden atmosphere found in and around industrial plants, refineries, steel mills, the processing industries, etc? Is it submersion in sewage treating vats, in salt brine, or in fresh water tanks?

No matter what your problem is, there is a TNEMEC Finish Coat to solve it. And remember . . . you will always save many maintenance dollars by doing the job *right*.

Ask Any TNEMEC User
(TEE-NEE-MIK)

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SEE OUR CATALOG IN SWEET'S

TNEMEC COMPANY, INC.

TNEMEC COMPANY, INC.
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Send my copy of your Catalog 50 to:

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"Can you furnish an efficient heat exchanger for 2 fluids of different transfer rates?"

"I need a stock design of heat exchanger for quick shipment."

"Do you have a standardized heat exchanger that can be used for a variety of services?"

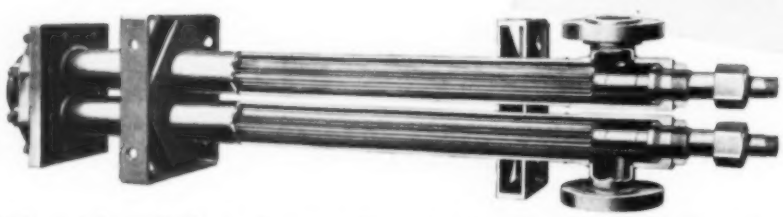
"Is it possible to get a heat exchanger with fins and tubes of different materials?"

"I want a heater system that will require least spare units."

FIVE QUESTIONS

One Answer...

THE G-R TWIN G-FIN SECTION



Yes, this "Universal Heat Exchanger" meets all these needs . . . and many more. It actually has the widest range of heating, cooling, condensing and heat exchange applications of any heat transfer apparatus on the market. • The G-R Twin G-Fin Section has proved its effective design and durable construction through 20 years of service. • This unit is the simplest type of heat exchanger, easy to install, economical to maintain, and with high salvage value because of its standardized design. Write for bulletin describing the many Twin G-Fin Section advantages in detail.

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GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

matters affecting the manufacture, sale, distribution and use of petroleum products.

Kenney began his association with Shell in 1937, serving as an attorney in St. Louis.

Hilleary, Napper and Miller Named by Standard (Indiana)

Standard Oil Company (Indiana) has appointed Harry L. Hilleary, who joined the company in 1947, group leader at the laboratory of its Wood River, Ill., research department. Max D. Napper, who joined the company in 1935, has been named group leader at the Casper, Wyo., laboratory.

In another appointment, Clarke C. Miller, who joined Standard in 1924 as a chemical engineer, has become information coordinator at the company's Whiting, Ind., research laboratories. Prior to his recent appointment, Miller was in charge of information facilities and co-ordinated related activities between company and cooperating laboratories.

Western Gulf Oil Announces Paloma Supervisory Changes

J. H. Jerome has been advanced to superintendent of plant operations and G. T. Naney has succeeded him as plant foreman in changes at Western Gulf Oil Company's Paloma Unit. Located near Bakersfield, Calif., the Paloma Unit is owned by six companies and operated by Western Gulf.

Jerome was employed at the Paloma Unit as an operator early in 1944 and was named plant foreman in 1945. Naney was assistant plant foreman until his latest promotion.

Department of Commerce Issues Report on Lubricant Additives

Department of Commerce's "Polyorganoxiloxanes, Organosilanes and Orthosilicate Esters As Antioxidants" reports that lubricant additives, used to improve all-around performance of special lubes and greases, also "accidentally" make these lubricants last longer.

Copies of the report may be bought for $.50 a copy from Office of Technical Services, Department of Commerce, Washington 25, D. C., with check or money order payable to Treasurer of U. S.

Industrial Waste Conference Set for May 4-6 in Indiana

The Eighth Purdue Industrial Waste Conference will be held in Lafayette, Ind., on May 4-6 this year. The purpose of the meeting is for scientists from industry and government to discuss mutual problems encountered in the disposal of waste materials that may result in the pollution of air or water.

Registration is open to anyone interested in waste disposal. The fee for attendance will not exceed $10.

Socony-Vacuum Names Baker to Manufacturing Committee Post

Charles P. Baker has been appointed vice chairman of the manufacturing committee of Socony-Vacuum Oil Company, Inc., succeeding George S. Dunham, re-

One of many reasons why skilled industrial maintenance men prefer the

AIRETOOL TUBE EXPANSION CONTROL SYSTEM

rolls tube joints tight automatically

Now science replaces "sensitive feel" in tube rolling! The AIRETOOL Tube Expansion Control System eliminates danger of over or under expansion. It automatically regulates the amount of expansion, produces maximum tightness and holding strength in every tube joint! With this system you can actually cut tube rolling time in half! Easy to use. Set dial for tube size, insert ball bearing expander and start powerful motor. When the tube joint reaches proper expansion and tightness, the control automatically shuts off the power. For more information and a convincing demonstration, write to:

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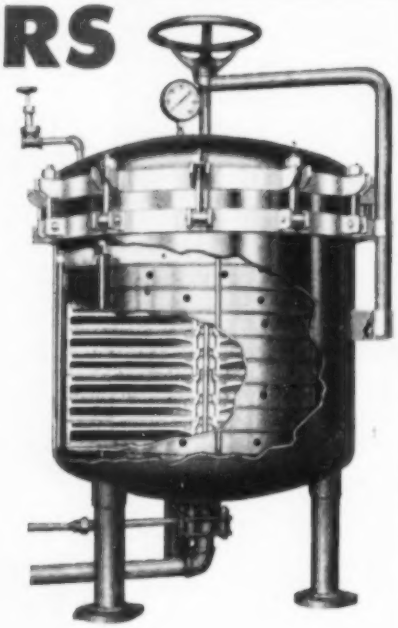
SPARKLER
HORIZONTAL PLATE
FILTERS

Noted for High Quality, Consistently Uniform, Fine Sharp Filtration of Petroleum Products....



Many times Sparkler filters have been chosen by experienced filtration engineers in the petroleum field because of these specific features of superiority.

Sparkler filters deliver unusually high flow rates due to the horizontal plate construction that requires only a very thin precoat to produce fine sharp filtration right from the start. Less pressure is required with a thin precoat resulting in a filter cake of less density and high flow capacity. Intermittent operation or variation in pressures will not disturb the stability of the filter cake.

Any grade of filter paper, cloth, or screens, and any filter aid can be used with maximum efficiency because no pressure is required to hold the filter cake on the plate.

Frequently Sparkler filters are used in the petroleum industry with various grades of paper only without filter aid to perform a specific job that would be difficult or impossible with some other types of filters such as the removal of water from diesel lube oil or transformer oil.

A few typical applications of Sparkler Filters to the Petroleum and petro-chemical industries for the filtration of:

- Canned lubricating oil
- Methyl-Ethyl-ketone
- Polyisobutane
- Chlorinated hydro-carbons (carbon tet.)
- Aviation gasoline
- Jet engine fuel
- Hydraulic oil
- Gas engine & diesel lubricating oil (both continuous recirculation on the engine and batch-wise)
- Diesel fuel oil
- Cooling tower water
- Plant effluent water (to obviate stream and lake pollution)
- Removal of Raney nickel from alcohol streams
- Insecticides
- Caustics & acids
- Cottrell precipitator insulating oil (carbon black plants)

Sparkler horizontal plate filters are available in capacities from 30 to 30,000 G.P.H. depending on type of product filtered. Can be supplied in carbon steel, stainless steel, pure nickel, or monel, bronze, Hastelloy and Inconel. Rubber lined, brine or steam jacketed.

Sparkler representatives for personal engineering service are located in Dallas, Houston, San Francisco, and other principal cities. Western Branch, Los Angeles, California.

SPARKLER

Write Mr. Eric Anderson for your nearest Sparkler service representative.

MANUFACTURING COMPANY
MUNDELEIN, ILL.

Sparkler International, Ltd. Prinsengracht 876 Amsterdam, Holland

MAKERS OF INDUSTRIAL FILTERS FOR OVER A QUARTER OF A CENTURY

cently elected to the company's board of directors.

Baker joined Magnolia Petroleum Company's, Socony-Vacuum affiliate in the Southwest, in 1934 and has been a member of the manufacturing committee since February 1, 1952.

Babin Retires; Cooper Named To Manage Venezuela Refinery

Calvin Cooper, assistant manager of Creole Petroleum Corporation's refinery

Cooper Davis

in Amuay, Western Venezuela, has replaced Chester L. Babin, manager of the refinery, who is retiring after 33 years of service in the U. S., Colombia and Venezuela.

F. K. Davis, operations superintendent in Amuay, replaces Cooper, while Montague Ball, from the company's refinery in Caripito, Eastern Venezuela, replaces Davis.

Babin began his career in the oil industry as a roustabout for Standard Oil of Louisiana in August, 1919.

Western Metal Congress Plans Talks on Metal Developments

Development of metals for use in the petroleum field and in refineries will be stressed by speakers and exhibits in the Western Metal Congress and Exposition, March 23-27, Los Angeles, according to program announcements.

W. H. Eisenman, secretary, American Society for Metals, stated that particular attention will be given to high temperature metals which are notable for their resistance to corrosion, acids and chemicals.

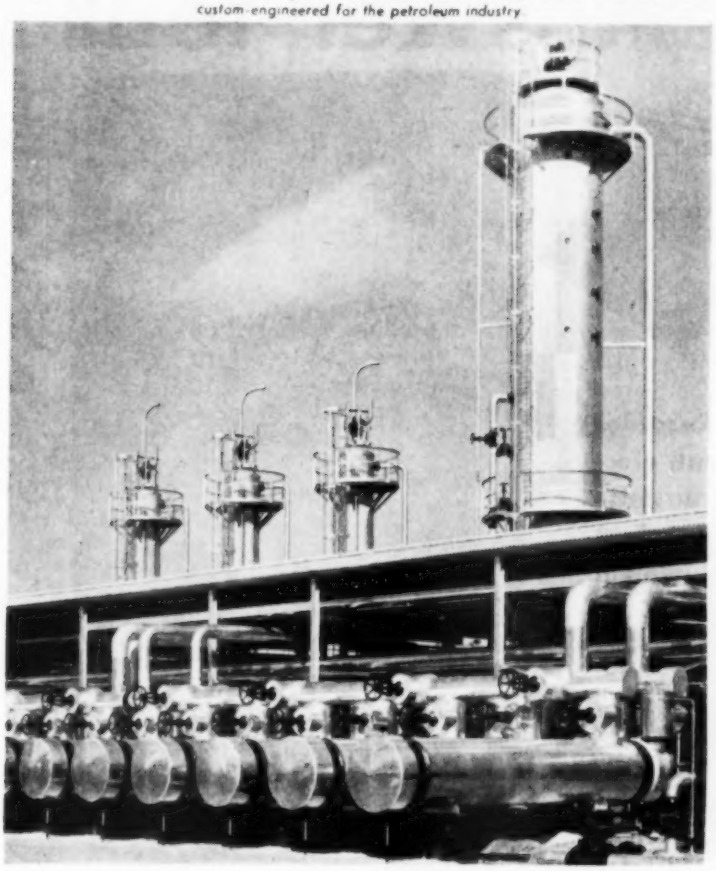
Technical sessions in the new Statler Hotel will be held by American Society for Metals, American Welding Society, American Society for Testing Materials, Society for Non-Destructive Testing, American Foundrymen's Society and American Institute of Mining and Metallurgical Engineers.

Tongberg to Direct Research In Esso Laboratories Changes

The Esso Laboratories of the Standard Oil Development Company, central research and engineering affiliate of the Standard Oil Company (New Jersey), has made known several major promotions.

Dr. Carl O. Tongberg, who joined the Esso laboratories in 1937, has become director of the research division of the Esso Laboratories; Dr. Charles L. Fleming, Jr., who joined Esso in 1938, has been made associate director; and Gordon W. Duncan, a member of the Esso organization since 1937, has been ap-

Major refineries from Beaumont to Bagdad rely on Alco heat exchangers and other equipment custom-engineered for the petroleum industry.



Aircoolers
Atmosphere and Submerged Cooling Sections
Bubble Trays
Butane and Propane Storage Tanks
Electric Welded Steel Pipe
Fabricated Plate Work
Fractionating Towers
Heat Exchangers
Prefabricated Pipe
Reboilers
Receiving Tanks
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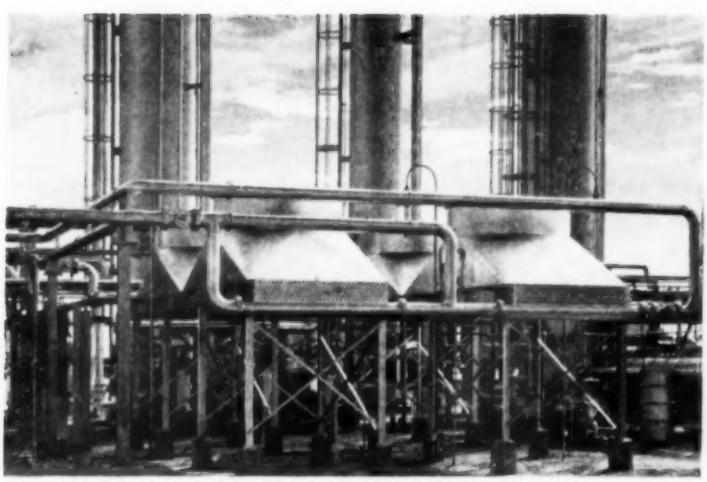
Steam Generators
Tank Suction Heaters
Transfer Line Exchangers

Weights: 100 to 300,000 pounds
Diameters: 4 inches to 12 feet
Pressures: high-vacuum to 3000 psi
Temperatures: −300 F to +1150 F

Need These?



Alco Aircoolers handle a wide variety of jobs with dollar-saving efficiency.

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Sales offices: Beaumont, Chicago, Dunkirk, Houston, Los Angeles, New York, Tulsa

ALCO PRODUCTS
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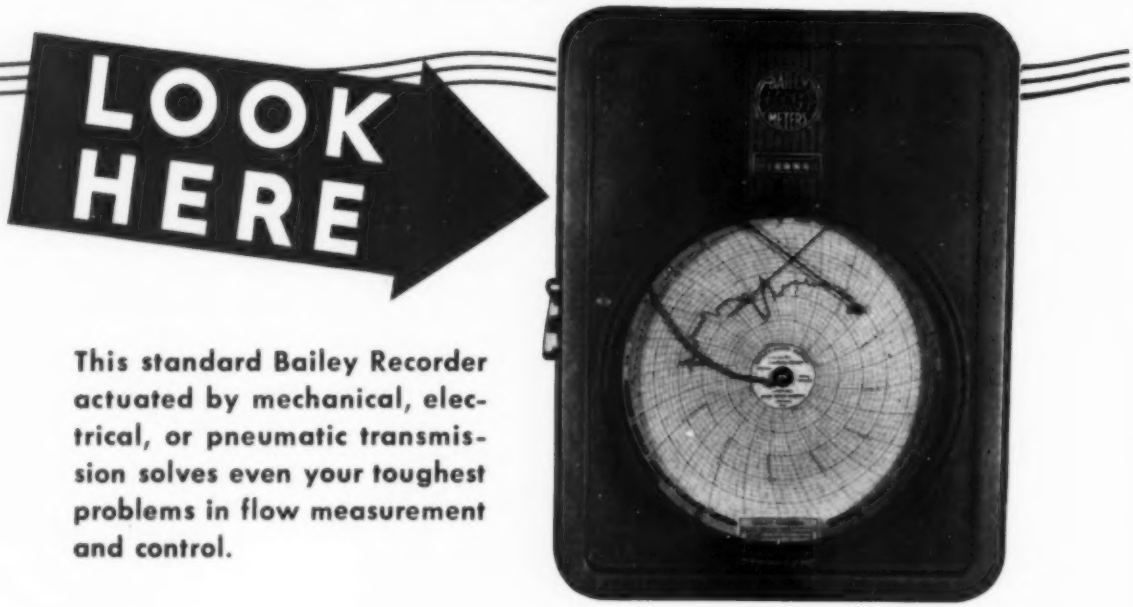
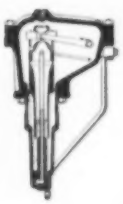
To Answer Your



This standard Bailey Recorder actuated by mechanical, electrical, or pneumatic transmission solves even your toughest problems in flow measurement and control.

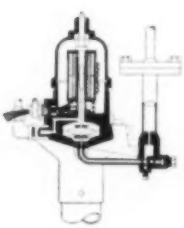
YOUR Choice of 7 Measuring Components:

...To measure steam, liquids, or high pressure gases in pipes use:



1 Ledoux Bell—

This shaped bell floating in mercury insures high accuracy and dependability throughout entire meter range. Records on uniformly graduated chart. For static pressures up to 2500 psig.



2 Mercury Float—

Actuates electric transmitter which has interchangeable range tubes. Electronic receiver records on uniformly graduated chart. For static pressures up to 2500 psig.

3 Bellows—

Actuates electric transmitter which requires no mercury, is readily portable and is easily adjustable to a wide variety of ranges. Electronic receiver records on uniformly graduated chart. For static pressures up to 3500 psig.

Bailey Meter Company

Flow Problems

...To measure liquids in pipes use:

4 Area Meter—

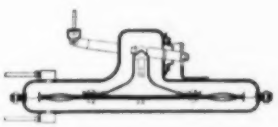
Variable area constant differential orifice actuates electric transmitter. For 1, 2 or 4″ lines in capacities from 1200 to 96,000 lb per hour and static pressures up to 600 psig.

...To measure low pressure gases in pipes and ducts use:

5 Inverted Bell—

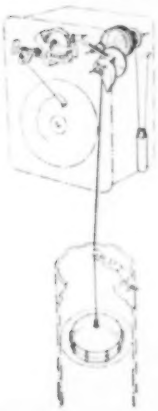
Sizes up to 12″ diameter furnish ample power with differentials as low as 2″ H_2O. Shaped displacer floating in mercury provides for uniformly graduated chart. Static pressure limits vary from 50 to 800 psig, depending upon bell size.

6 Diaphragm—



44 square inches in area opposed by shaped displacer floating in mercury actuates uniformly graduated chart recorder. Suitable for differentials from .5″ to 7″ H_2O and static pressures up to 70″ H_2O.

...To measure liquids in open channels use:



7 Open Float—

Actuates uniformly graduated chart recorder through pulley-operated cam and gear train. May be calibrated to any maximum head between 5″ and 360″ of liquid flowing in channel.

•

Ask your local Bailey Engineer to assist you in applying Bailey Meters to your measurement and control problems.

C 8

1043 Ivanhoe Road
CLEVELAND 10, OHIO

Meters and Controls
For
Power and Process

You simply can't beat this new

RIDGID

Spiral for smooth easy reaming

★ This new improved Spiral reams burr from pipe as fast and cleanly as if it were wax . . . and makes quick work of enlarging conduit box outlets or cutting holes in sheet metal—and does it without chatter.

★ Improved ratchet handle—cutting edges of heat-treated tool steel for long service. You can't beat it for performance. Buy at your Supply House.

Remember also RIDGID LonGrip Reamer with extra-long taper.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

RIDGID

Work-Saver Pipe Tools

pointed an assistant director.

The company has also named two new section heads in its research division. Dr. Joseph P. Hammer is to head the automotive fuels and lubricants sections, and Elfried F. H. Pennekamp the additives section. As a part of the same changes, George S. Tobias takes new responsibilities as aviation contact representative.

Duke, Sampson And Robinson Promoted in Sun Oil Division

Appointment of Charles B. Duke as manager of the refinery supply and distribution division of Sun Oil Company's manufacturing department has been announced. He succeeds Donald Lincoln, who died recently.

Duke

Edward H. Sampson, Jr., has been named assistant manager of the division in charge of supply, and Wirt R. Robinson, assistant manager in charge of distribution.

Duke joined Sun Oil as a yield clerk in 1934 at the Marcus Hook, Pa., refinery. He was advanced from the manufacturing department in 1947 to special assistant in the division he now manages.

Sampson joined the company in 1931 at the Marcus Hook refinery. He has been a member of the refinery supply and distribution division since 1931.

Robinson was vice president of the Ediplate Corporation prior to joining Sun Oil in 1933.

Sun Oil's House Publication Gets New Editor, Associate

William H. Burns, associate editor of *Our Sun*, quarterly house publication of Sun Oil Company, has been named editor of the publication, succeeding William J. Getty.

Getty, editor of the quarterly since July, 1949, has been promoted to the public relations department's special events division.

Other Sun Oil public relations department changes announced were: Henry C. Gulbrandsen, editor of the monthly *Sun Refinery News*, to be associate editor of *Our Sun*, succeeding Burns; Earle W. Palmer, public relations staff assistant, Philadelphia, to be editor of *Sun Refinery News*, replacing Gulbrandsen; and Ellen C. Talbot, special assistant to the director of public relations, transferred to Pew Memorial Foundation.

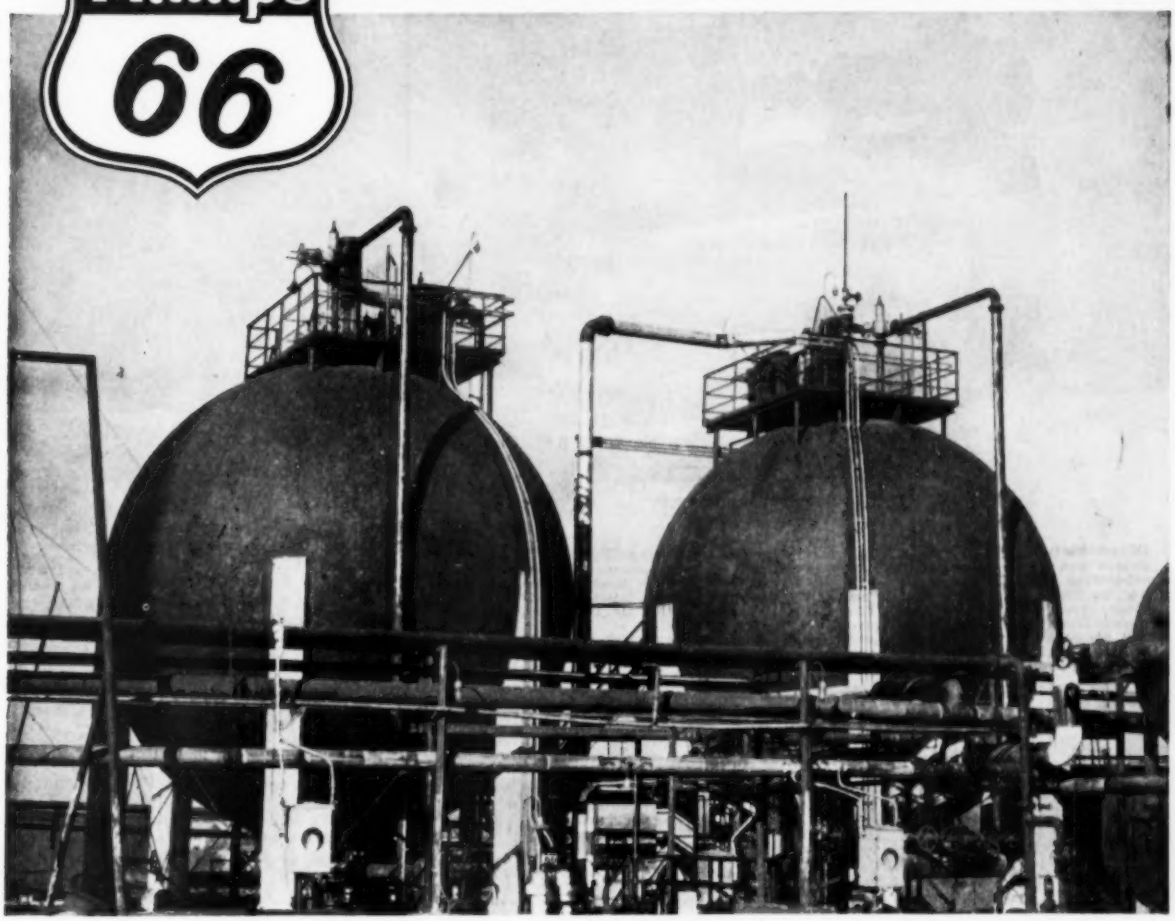
Philips Diffraction School Slated for New York in April

The Spring session of the Philips semi-annual Diffraction School will be held at North American Philips Company's Mount Vernon, N. Y., plant during the latter part of April. Exact dates and program details will be announced later.

Basic subjects to be covered include x-ray diffraction, new high and low temperature camera techniques, fluorescence analysis, Geiger-counter x-ray Spectrom-

Phillips 66

another leading refiner who desalts with PETRECO



Phillips Petroleum Company has earned a place of leadership in the oil industry by manufacturing and marketing products of the highest quality. To consistently produce excellent products, a refining organization must possess and utilize a high degree of technological know-how.

One phase of Phillips know-how is their insistence on the absolute minimum of residual salt in the crude charge. Like other leading refiners, Phillips knows that salt in the crude charge, even in nominal tolerances, is a certain trouble-maker. The fact that Phillips utilizes Petreco Electrospheres at Phillips, Texas, to hold the salt content of the crude charge to this refinery to their required low minimum is of considerable significance.

Like other leading refiners everywhere, Phillips not only produces the best products possible – they help to assure this excellence of product by utilizing Petreco Desalting, the desalting process with an established reputation and known standards of performance and service.

Complete information on Petreco Electric Desalting and other refinery processes is yours for the asking.

PETROLITE CORPORATION
PETRECO DIVISION

PETRECO

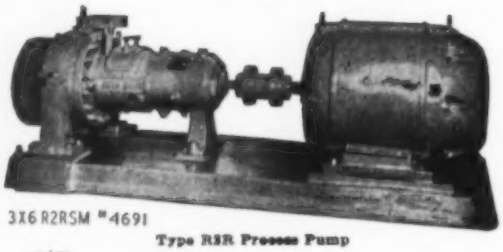
ELECTRIC PROCESSES FOR THE PURIFICATION OF PETROLEUM

CRUDE OIL: **REMOVAL OF SALTS, SOLIDS AND OTHER IMPURITIES; DEHYDRATING**
DISTILLATES: **ACID, CAUSTIC AND DOCTOR TREATING**
FUEL STOCKS: **DESAPONIFICATION**

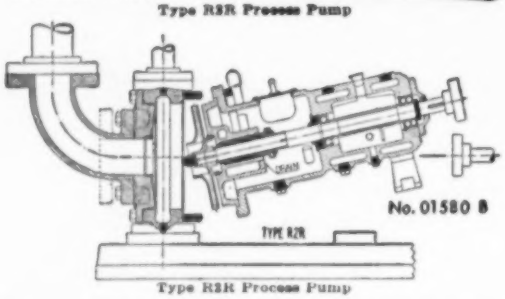
PR 50-4

DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



Type R3R Process Pump



Type R3R Process Pump

DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE: Type R3R. Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.
Capacities: 50 to 2000 Gallons per minute.
Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

BUILDERS OF OUTSTANDING PUMPS SINCE 1869

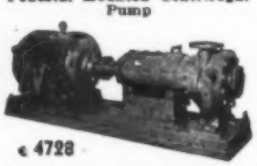
CENTRIFUGAL and RECIPROCATING PUMPS

Close Coupled Centrifugal Pump

Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids

Pedestal Mounted Centrifugal Pump

Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump



Double Pedestal Bearing Centrifugal Pump

Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

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Representatives in Principal Cities

eter, and Electron microscopy and Electron diffraction. There is no registration fee for the meetings.

Dunham and Bartlett Elected Socony-Vacuum Board Members

The board of directors of Socony-Vacuum Oil Company, Inc., has elected George S. Dunham, vice chairman of the company's manufacturing committee, as a new member of the board. Another newly elected member is Fred W. Bartlett, general manager of the producing department. Wilbur F. Burt, vice president and director in charge of coordination, is retiring after 40 years of service.

Dunham

With the election of the two new members, the company's board was increased from 11 to 12 members.

In other board action, Charles L. Harding, a director since 1948, was elected a vice president and member of the executive committee. Clark S. Teitsworth, a director since 1947, was designated to succeed Burt in charge of coordination, while Dunham succeeded Teitsworth on the manufacturing committee.

Survey Shows Many More Cities Getting Higher Octane "Gas"

Thirty-eight out of 50 cities surveyed in the U. S. and Canada in January, 1953, had premium-grade gasolines averaging 90 octane Research or better, compared with 28 in January, 1952, according to E. I. du Pont de Nemours & Company's petroleum chemicals division.

Twenty out of 50 cities in the survey had regular-grade gasolines averaging 85 octane Research or better, compared with 12 in January, 1952. The lowest average rating for premium in January, 1953, was found in Calgary, Alba., which was also low in October, 1951. From October, 1951, to October, 1952, inclusive, El Paso, Texas, held the low rank.

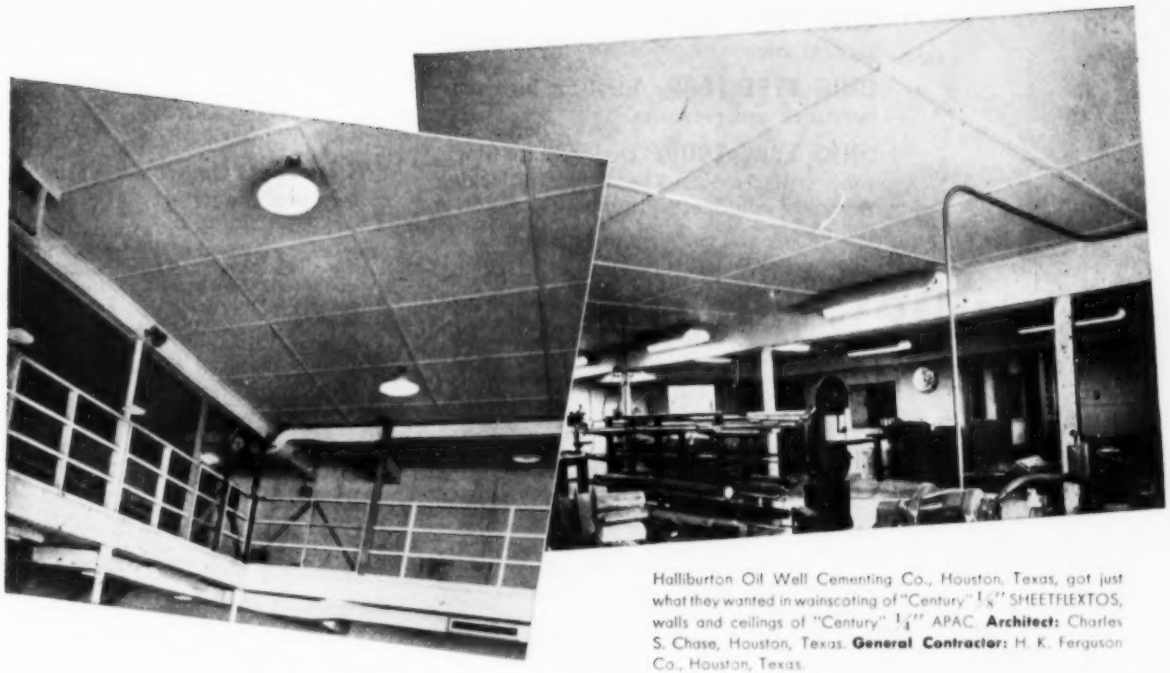
The highest average rating for premium shifted to Cleveland, Salt Lake City was found to have the lowest average for regular grade, while Boston and Columbus, Ohio, shared honors for highest average for regular.

Catalyst Deactivation Slated For Armour Research Project

Armour Research Foundation of Illinois Institute of Technology recently initiated a fundamental research project on catalyst deactivation.

Sponsorship of the project is in line with the Foundation's policy of making contributions to fundamental knowledge as a public service. The support of industry will be sought when larger appropriations appear justified to achieve objectives.

"Although great strides have been made in clarifying the mechanism of catalyst action," Kenneth W. Miller, assistant director of research, said, "the



Halliburton Oil Well Cementing Co., Houston, Texas, got just what they wanted in wainscoting of "Century" $\frac{1}{8}$" SHEETFLEXTOS, walls and ceilings of "Century" $\frac{1}{4}$" APAC. **Architect:** Charles S. Chase, Houston, Texas. **General Contractor:** H. K. Ferguson Co., Houston, Texas.

Walls without worries

. . . ceiling without overhead

with "CENTURY"

ASBESTOS-CEMENT SHEETS

Halliburton Oil Well Cementing Co. wanted strong, good-looking walls and ceilings that would be *fire-resistant* and *easy to clean*. That's why they chose "Century" SHEETFLEXTOS for wainscoting applied over solid sheathing and "Century" APAC secured right to studs and joists for upper walls and ceilings.

Fire-resistance, of course, is an outstanding feature of these structural boards, combined as they are of virtually indestructible asbestos fiber and portland cement. Ease of cleaning, too, comes "naturally" to their hard, smoothly-textured surfaces that can't be hurt by water, dampness, or rot, and need no protective painting.

But look at the *extra* features that go with "Century" APAC and SHEETFLEXTOS. Both Sheets are also resistant to rodents, immune to termites. They go on fast, in big sheets (standard 4′ x 8′) that can be cut or drilled on the job, and fastened easily with screws or ring-fettered nails. They obviate the need for laths and plaster, and, while they require no painting at all, they take decorative colors well. SHEETFLEXTOS, as its name implies, has the added advantage of flexibility, to make curves and domes where indicated.

Both "Century" APAC and "Century" SHEETFLEXTOS make good surroundings for successful work and enjoyable living. Figure on one or both for your attractive, fire-resistant interiors. Write us for further details about these economical products . . . and name of your nearest distributor.

Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

K&M Cat in asbestos

KEASBEY & MATTISON
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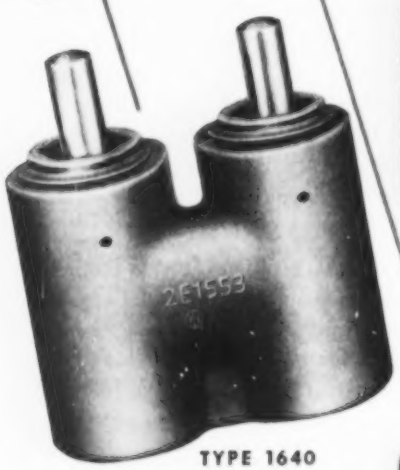
3 most popular OHIO RETURN BENDS

OHIO TYPE 1000: Adaptable to wide general use.

OHIO TYPE 1640: Ideal for high temperatures and pressures.

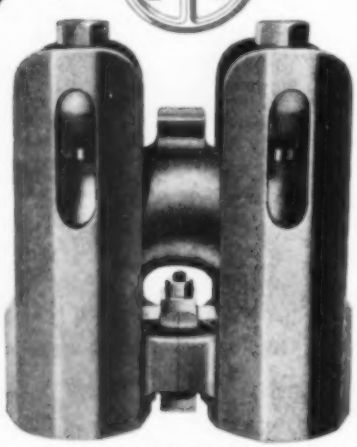
OHIO TYPE 2000: Designed for single tube replacement. The patented locking assembly eliminates the necessity for a rolling jig.

Descriptive pamphlets of any of the above designs will be mailed on request.



TYPE 1640

TYPE 1000



TYPE 2000

THE OHIO STEEL FOUNDRY COMPANY

LIMA, OHIO

PLANTS AT SPRINGFIELD AND LIMA, OHIO

fundamental changes in catalyst structure that cause or accompany deactivation of contact catalysts are not so well understood."

NGAA Sets Up Program For Regional Meeting in Midland

The tentative program of the Natural Gasoline Association of America's Permian Basin Regional meeting has been announced. Registration for the one-day meeting is scheduled for 8:00 a.m. on the mezzanine of the Scharbauer Hotel, Midland, Texas, on February 27.

The announced program is divided into two sessions, with entertainment scheduled for the evening.

Morning session, 9:30—W. L. Phillips, Phillips Petroleum Company, Odessa, Texas, chairman. Opening Remarks, NGAA president, John F. Lynch, president, La Gloria Corporation, Corpus Christi, Texas; "Accident Problems and Safe Practices in Natural Gasoline Plant Operations," W. J. Rogers, Magnolia Petroleum Company, Dallas; "Yardstick for Promotion of Employes," W. C. Ford, Industrial Relations Consultant, Houston; "Preventative Maintenance for Centrifugal Pumps," F. B. Applegate, Pacific Pumps, Inc., Huntington Park, Calif.

Afternoon session, 2:30—G. E. Kendricks, El Paso Natural Gas Company, Jal, N. M., chairman. "What You Can Expect of Communistic Russia," Robert E. Stripling, attorney, Midland; "The Effect of Pre-cooling Combustion Air for Gas and Diesel Engines," W. R. Crooks, The Cooper-Bessemer Corporation, Mt. Vernon, Ohio; "Experience in the Control of Corrosion in Cooling Water Systems," W. A. Tanzola, W. H. & L. D. Betz, Philadelphia; "Refining Oil for Energy," a sound motion picture in color, courtesy Shell Oil Company.

5:30 p.m.—"Cooling Tower," courtesy Natural Gasoline Supply Men's Association; 7:00, Dinner and Entertainment, with E. D. Dickey, Shell Oil Company, Midland, toastmaster.

Staff Additions and Promotion Announced for Humble Refinery

Humble Oil & Refining Company has announced the following staff additions to its Baytown, Texas, refinery:

R. A. Herrington, B.S. in architectural engineering, University of Texas, and C. O. Rhys, Jr., Standard Oil Development Company, to engineering division; William G. Domask, Ph.D. in chemical engineering, University of Texas, Harold C. Nix, Dugway Proving Grounds, and William A. Burrell, Buckeye Cotton Oil Company, to technical service division; and James F. Mathis, Ph.d. in chemical engineering, University of Wisconsin; to research and development division.

At the same time the company announced the promotion of Dr. C. H. Kollenberg to assistant division head of the technical service division at Baytown. Dr. Kollenberg joined Humble in 1940, going there from the University of Texas where he received his Ph.D.

Murray Made Honorary Member Of American Chemists Institute

Honorary membership in the American Institute of Chemists has been awarded to R. Lindley Murray, president of Hooker Electrochemical Company. Murray is the 46th recipient of honorary membership in the Institute since its founding in 1924.

Schiessler Wins ACS Award

American Chemical Society will present Professor Robert W. Schiessler, of The Pennsylvania State College, an authority on the chemistry of high-purity

WHEN CORRECTLY ENGINEERED, weight reductions in the design of fractionating towers can mean far-reaching savings in time and dollars! Here's how:

A bubble tray, otherwise constructed, might require *eight* men to lift it. A tray of equal capacity, designed to take advantage of the high strength and corrosion-resistant qualities of ENDURO Stainless Steel, can be handled by *two* men.

With as much as 75% of the weight saved, lighter hoisting equipment can be used during installation—or any subsequent maintenance. Psychological and physical hazards to men, working within the confines of the tower, are removed.

High in strength-to-weight ratio—valiant under pressure—unfazed by heat—tough, long-lasting ENDURO stubbornly resists aggressive corrosive action. Coking has little affinity for the smooth, corrosion-resistant surface of ENDURO. "Off-stream" time, due to coking and fouling, is substantially reduced.

Thus, any slightly higher initial cost of ENDURO Stainless Steel is *dwarfed* by savings realized in avoiding "down-time", product and equipment loss, and product contamination.

Doing some advance planning? Republic metallurgists stand ready to work with you at any time on future developments calling for the use of stainless steels. Just write:

REPUBLIC STEEL CORPORATION
Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

See and Hear
"THE STORY OF STAINLESS"

Full-color, 16 mm sound film—27 minutes running time. Dramatic . . . historic . . . interesting. Available to qualified groups without charge. Requires 16 mm sound projector. Send name of organization, type of projector, requested date to Ideal Pictures Corp., Dept. T-4, 65 E. So. Water St., Chicago 1, Ill., or write Republic Steel, Dept. K, Cleveland 1, O.

Republic
REPUBLIC STEEL
ENDURO STAINLESS STEEL

Other Republic Products include Upson Bolts, Studs, Nuts and Rivets—Pipe—Sheets—Plates—Electrunite Heat Exchanger Tubes

PETRONATE* (Oil Soluble)

HYPONATE* (Oil Free)

PYRONATE* (Water Soluble)

PETROLEUM SULFONATES

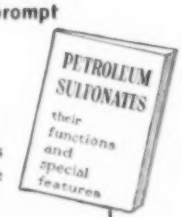
. . . made to your specifications for use in products such as . . .

- *rust preventive formulations*
- *soluble cutting oils*
- *soluble textile oils*
- *emulsion degreasing compounds*
- *fuel oil additives*
- *emulsifiers for agricultural and insecticide sprays*
- *special emulsifying formulations*

Ask Sonneborn about PETRONATE, the oil soluble petroleum sulfonate available in various molecular weights; HYPONATE, an oil free petroleum sulfonate; and PYRONATE, a water soluble petroleum sulfonate effective as an emulsion breaking reagent.

Sonneborn petroleum sulfonates—superior in quality and possessing exceptional uniformity—are now made to fit a wide variety of specific needs. They can also be tailor-made to your exact specifications. You can rely on prompt shipment.

*Reg. U. S. Pat. Off.



Free Informative Booklet

This valuable booklet gives highly useful data on the many ways PETROLEUM SULFONATES are being and can be used. Write today for this highly informative booklet.

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Achieved by Sonneborn RESEARCH

petroleum products, the $1000 Precision Scientific Company Award in Petroleum Chemistry on March 16 in Los Angeles.

The presentation will take place at a general assembly in the Hotel Statler during the society's 123rd national meeting.

Two Named Heads of Kellogg Operating And Construction

Joseph W. Smith has become general manager of construction and Henry P. Wickham manager of the operating division in two appointsments made by The M. W. Kellogg, a subsidiary of Pullman Incorporated.

Wickham Smith

Smith joined Kellogg in 1936, and since that time has been in the construction department, most recently as assistant manager.

Wickham, long associated with Kellogg's fluid catalytic processing developments, will be, in his new position, "largely concerned with the company's desire to broaden its long-standing technical service efforts."

Fulton Recalled from France; To Assist Lummus President

The Lummus Company has recalled David Fulton to the company's main office in New York. Prior to recall, Fulton was for a number of years manager of Lummus' French affiliate, Societe Francaise des Techniques Lummus, in Paris. He returns to assume his newly appointed position as assistant to the president.

ACS Schedules Symposium

A symposium on "The Literature of Chemicals Derived from Petroleum" will be presented at the Los Angeles meeting of the American Chemical Society on March 16 and 17. Nine papers are expected to be presented at the two-day symposium.

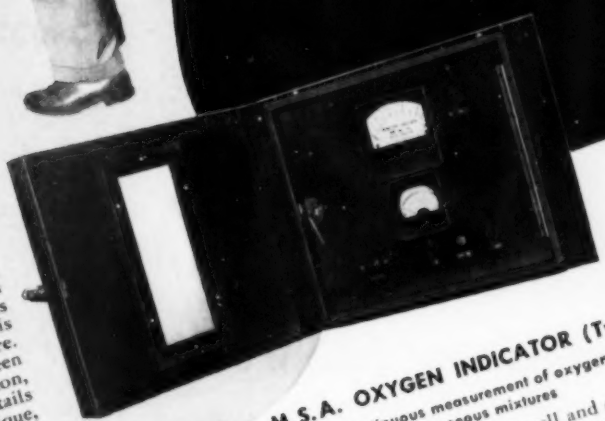
California Standard Vet Dies

Thomas L. Taggart, manager of the natural gasoline department of Standard Oil Company of California since 1942, died recently in San Francisco. He had worked for Standard since 1927.

Valve Picture Misplaced

On page 167 of this issue's New Equipment Section, item number 35 entitled "Self-Tightening Valve" is erroneously accompanied by a picture. In the March issue the picture will again appear along with correct descriptive material.

M·S·A· INSTRUMENTS for Continuous PROCESS CONTROL



THE M.S.A. INFRA-RED GAS AND LIQUID ANALYZER (LIRA TYPE)

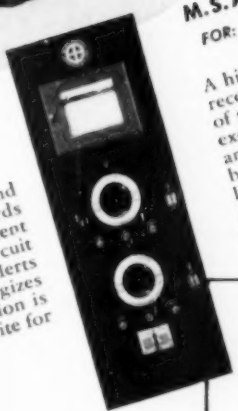
FOR: • Automatic analysis of fluid mixtures
• Measuring toxic contaminants in air
• Precise process control

Any process involving infra-red absorbing gases or liquids presents an ideal application for this accurate, sensitive instrument. This device makes a continuous and rapid analysis for one component of a sample mixture. The stability of the instrument has been proved in a wide variety of production, control and research problems. For details on operation, selective analysis technique, construction and application, write for our bulletin.

M.S.A. OXYGEN INDICATOR (Type C)

FOR: • Continuous measurement of oxygen content of gaseous mixtures

A highly sensitive detector cell and electronic recorder which produces a continuous record of the concentrations of oxygen in the sample exercises automatic control over combustion and other production processes. The unit has been successfully applied to chemical, metallurgical and petroleum operations. Maintains inert atmospheres; measures combustion efficiency; aids control of pipe line corrosion. Write for details.



M.S.A. COMBUSTIBLE GAS ALARM

FOR: • Safe, continuous sampling and control of combustible gas hazards

Provides a means of continuous analysis and control of potential explosive and toxic hazards before they become critical. This instrument operates on a balanced electrical bridge circuit principle. Audible and visible alarm alerts personnel, and at the same time energizes external control circuits until the condition is corrected. Explosion-proof housing. Write for details.

OTHER M.S.A. INSTRUMENTS FOR PROCESS CONTROL

Continuous Carbon Monoxide Detectors and Recorders—Portable Instruments for appraising various gas and dust hazards.

What's your problem?

Our years of know-how in process control instruments is at your service. We have complete and experienced research facilities to apply to your particular problem. Let us know what you need. We'll be happy to follow through.

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SAFETY EQUIPMENT HEADQUARTERS

Call the M.S.A. Man on your every safety problem . . . his job is to help you.

BH POWERHOUSE CEMENT

in the bag this MORNING

reducing heat loss . . . upping output by NOON

That's how quickly and easily you can apply this finishing cement which also insulates. Pointing, sealing, applying and finish-trowelling can be done with a single coat and one scaffold setting. Applied over B-H Mono-Block or a refractory or firebrick, it provides effective permanent insulation—a smooth finish which takes both oil- and water-base paints.

Powerhouse, itself, is effective up to 1700° F. and is figured as part of the insulation . . . If you are having trouble holding down heat losses, let us discuss the problem with you. Call on B-H Engineered Insulation Service.

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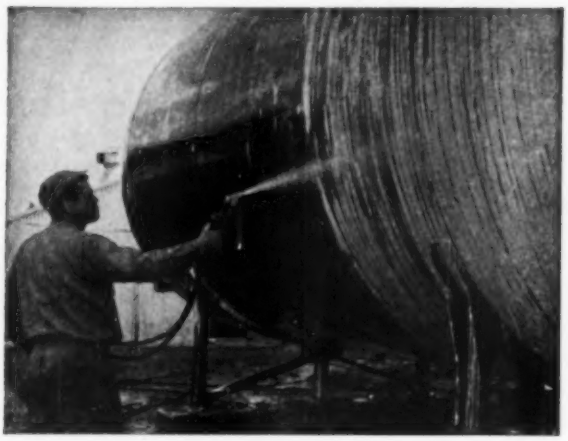
Please send complete information on

- ☐ POWERHOUSE CEMENT . . . High adhesion, black rockwool, insulating-finishing cement
- ☐ BLANKETS . . . Metal-reinforced, flexible, felted, black rockwool insulation
- ☐ NO. 1 INSULATING CEMENT . . . All-purpose, rust-inhibiting, plastic cement
- ☐ MONO-BLOCK . . . Rigid, felted black rockwool block—for high and low temperature use

How to strip a storage tank



without scraping or sandblasting

BUT FAST—that's how old coats of paint roll off when you strip tanks the quick, money-saving Oakite way.

Powerful Oakite strippers, applied by hot-flow-on, steam-gun, or cold-flow-on method, actually float off paint, dirt, and grease—right down to the base metal. You save time . . . no hand scraping, chipping or blasting. You save money . . . long-life solution may be reclaimed and reused. And you're safe . . . no fire hazard.

Ask your local Oakite Technical Service Representative for on-the-spot demonstration. Or write Oakite Products, Inc., 50B Rector St., New York 6, N. Y., for details.

FREE Booklet F7629—full of information on maintenance cleaning in all divisions of the Petroleum Industry—describes proved, money-saving Oakite procedures for such jobs as

- cleaning stabilizing towers
- cleaning tank car interiors
- descaling heat exchangers in place
- reconditioning barrels
- salvaging rigs, valves, fittings

Copy sent on request. Write today!

Technical Service Representatives in Principal Cities of U. S. & Canada

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PETROLEUM SERVICE DIVISION

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No. 1050-MF
R-P&C Chrome
Stainless Steel
Bar Stock Valve

Positive Flow Control

• For special hookups such as well head assemblies and gauge panels, the R-P&C Bar Stock Valve has no equal. It is a fine throttling valve that positively controls the flow.

Male and female end type is made of carbon or chrome stainless in ¼" and ½" sizes, in globe and angle types. Other bar stock valves are made of bronze, stainless, or carbon and stainless steel in sizes ⅛" to 1". High pressure and temperature ranges.

See your R-P&C distributor or write nearest R-P&C district office for information on precision turned Bar Stock Valves.

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AMERICAN CHAIN & CABLE
Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P&C valves

[Construction]

The items supplement those appearing on page 80 et seq. The quarterly tabulation of construction items will appear next in the April issue.

$7 Million Turkish Refinery To Be Built by Ralph Parson

Ralph Parson Company of Los Angeles has been signed to build an oil refinery in Turkey for Turkish Institute of Minerals Prospecting. When completed it is expected to process around 6000 barrels a day. To cost $7 million, the refinery will take two years to complete.

U. S. specialists will supervise the first year of operation; it will then be taken over entirely by the Turkish government. The refinery is to be situated in southeastern Turkey.

Turkey has a current crude productive capacity of about 1000 barrels a day, according to an estimate by PAD officials in Washington. They estimated that actual production is running about 300 to 400 barrels a day.

Sinclair Begins Work to Up Capacity of Wyoming Refinery

Sinclair Refining Company is proceeding with additions to its Sinclair Wyo., refinery which will permit complete processing of some 6000 barrels of additional crude per day. These additions consist of new equipment which will remove bottlenecks on the crude and vacuum stills, together with a new air blower for the Fluid Cracker which will increase its capacity from 9000 to 12,000 barrels a day. The new facilities are expected to be completed early in the Summer of 1953.

Canada Southern Oil Plans New-Type Refinery in Canada

Plans for construction of a new-type 10,000- to 20,000-barrel-a-day refinery in Saskatchewan are nearing completion. To cost from $7 to $10 million, the refinery will be sponsored by Canada Southern Oil and associated New York interests for refining heavy crude such as is produced in the Lloydminster and Coleville fields in Saskatchewan.

Pacific Refinery Construction Delayed by Steel Allotment

Construction of Pacific Oil & Refining Company's proposed refinery on Puget Sound in the Pacific Northwest has been delayed because PAD will not be able to grant any steel allotments before the third quarter this year.

Pure Oil Awards Contract For Construction at Ohio Refinery

Catalytic Construction Company of Philadelphia has been awarded a contract by Pure Oil Company of Chicago for construction of additional boiler house facilities and auxiliaries at Pure's Toledo, Ohio, refinery.

The work will be in connection with new catalytic cracking facilities and new copper oxide naphtha treating units now being installed at the refinery. This phase of the Toledo project is expected to be completed in July of this year. The various units now under construction are the nucleus of a major expansion program undertaken by Pure at the Toledo refinery.

[Construction]

Heyden and Monsanto to Share 50-50 on Texas Methanol Unit

An agreement to build a methanol plant adjoining Monsanto's new acetylene facilities, at Texas City, Texas, has been entered into by Heyden Chemical Corporation and Monsanto Chemical Company.

The two companies will share equally in the cost and construction and in the output of the plant, which will use by-product gas from the acetylene operation and will have a capacity of about 1600 barrels a day. Commercial production is expected to begin in January, 1955.

Ingram Products Expanding Its New Orleans Refinery

A catalytic cracking unit, gas recovery plant and polymerization, and vacuum plant are included in the enlarging and revamping of Ingram Products Company's plant near New Orleans. The project, for which Process Construction, Inc., is the contractor, is to be completed by January 1, 1954.

Total investment in the plant when completed will be $3.7 million, and the throughput capacity of all units will be 7000 barrels a day.

Biggest Industrial Venture in Alberta Almost Completed

The $54 million plant of Canadian Chemical Company, Inc., now under construction eight miles east of Edmonton, represents the largest industrial venture ever undertaken in Alberta, according to an announcement by the company.

Other unique features of the project are: 1) it is the first major development to use Western Canada's petroleum and natural gas reserves in a petrochemical operation; and 2) it is the first significant move in the establishment of a synthetic fiber industry in the western half of the North American continent.

Completion of construction is anticipated early this year.

Prime Contractor Named For New (Indiana) Standard Unit

Standard Oil Company (Indiana) has selected The M. W. Kellogg Company as prime contractor for construction of a new 700 barrel-a-day alkylation unit at its Casper, Wyo., refinery. The design of the new unit is already in the final stages. Construction is expected to begin in the Summer of this year, with initial operation scheduled for may, 1954.

Pemex Invests $22 Million In Refinery Modernization

Petroleos Mexicanos has invested about $21.9 million in amplification and modernization of installations at its Cuidad Madero, Mexico, refinery. The company has already done much modernization work but its program calls for the investment in the next six years of $69.4 million in development of Mexican refineries.

August Set as Completion Date For Taylor Oil & Gas Refinery

Taylor Oil & Gas Company has estimated that the new Platformer being built at its Corpus Christi, Texas, refinery will be completed about August, 1953. This plant is currently rated at 40,000 barrels a day.

Other major processes now in service include cat polymerization, thermal cracking and visbreaking.

Monsanto Starts Production of Vinyl Chloride Monomer

Vinyl chloride monomer made from acetylene, hydrochloric acid, ethylene and chlorine is being produced and regularly shipped at Monsanto Chemical Company's Texas division plant at Texas City.

The new monomer is being shipped in tank cars and in small and intermediate size pressure cylinders.

Sarpom Plant Begins Operation

Caltex Oil Products Company, affiliate of California Texas Oil Company, has announced the start of operations at a newly constructed refinery at San Martino di Trecate, between Milan and Turin, Italy.

Formal opening ceremonies are planned for the Spring of 1953 for the refinery, which is owned by Sarpom (Societe Azioni Raffinerie Padana Olii Minerali), composed jointly of Caltex and Fiat Company.

is the title of a new Tracerlab pamphlet that surveys most of the known applications of radioactivity in the oil industry. The booklet has been prepared in the belief that such a brief but detailed survey will prove a stimulus to present users to develop new applications, and present a challenge to those firms not now utilizing the unique properties of radioisotopes. A valuable, three page bibliography is included.

Just a word about Tracerlab. Since its founding in 1946, Tracerlab has developed into the largest integrated company in the nuclear field. We produce the most complete line of instruments and accessories; prepare the largest number of "tagged" radiochemicals; and provide the most comprehensive consulting service available in our field of specialty.

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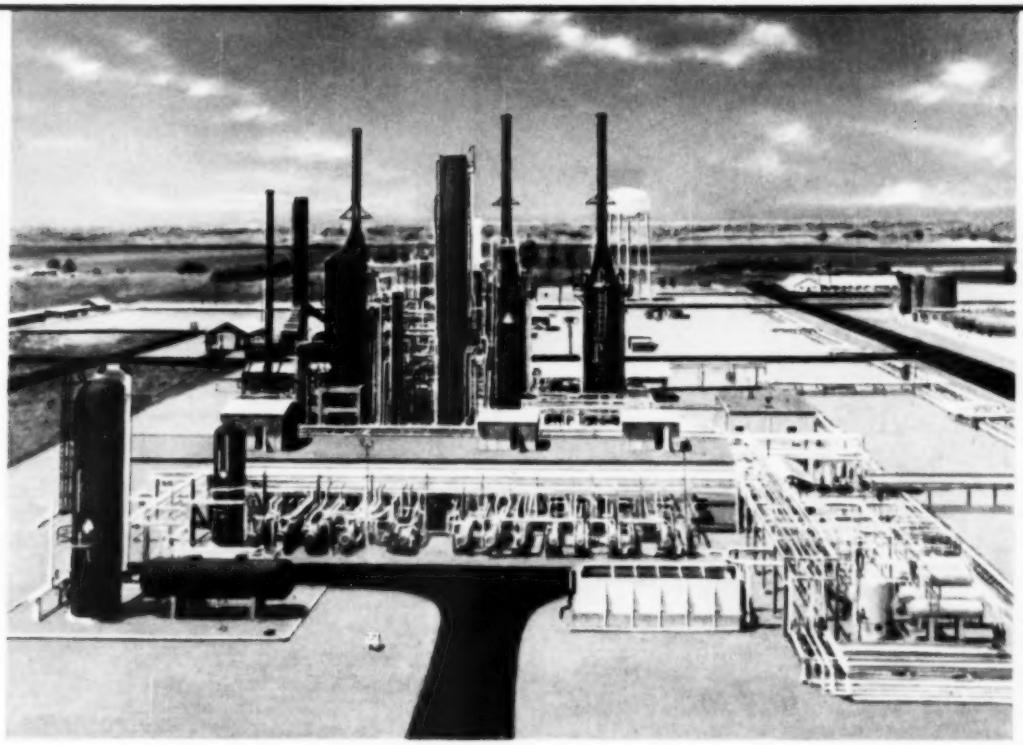
NEW HORIZONS



The Crude Distillation and Vis-breaking Unit of Sarnia Refinery, designed by Badger Process Division, processes 20,000 barrels per day of Alberta crude oil

Sarnia Refinery of Canadian Oil Refineries, Limited, is the first large, integrated refinery in Canada built for processing Canadian crude oil. It brings to this rapidly growing region the last word in technological progress in the field of petroleum refining. Such progress means better quality of product and greater efficiency in operation. Design and construction of the refinery were managed by Stone & Webster Canada Limited, utilizing the facilities of Stone & Webster Engineering Corporation.

STONE & WEBSTER ENGINEERING CORPORATION

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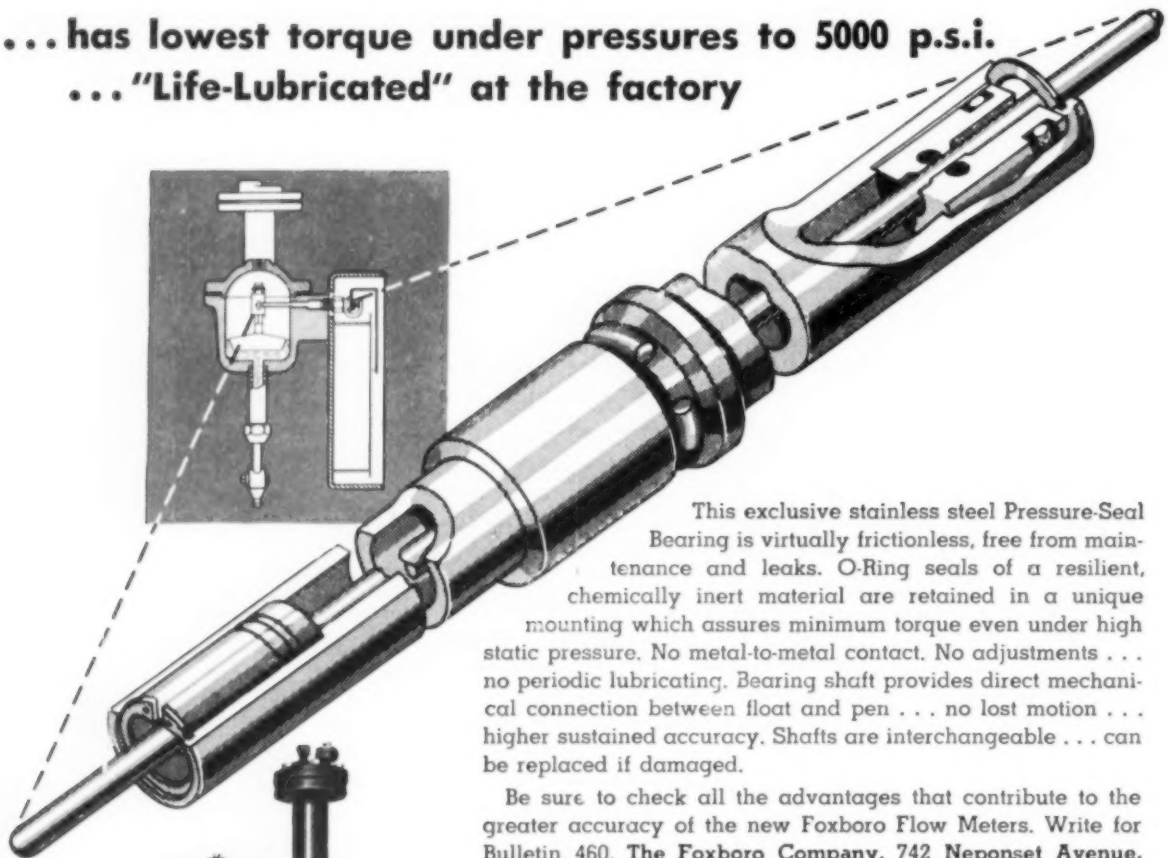
STONE & WEBSTER CANADA LIMITED

E. B. BADGER & SONS (Great Britain) LTD.

You've never seen a meter bearing as trouble-free!

...has lowest torque under pressures to 5000 p.s.i.
..."Life-Lubricated" at the factory



This exclusive stainless steel Pressure-Seal Bearing is virtually frictionless, free from maintenance and leaks. O-Ring seals of a resilient, chemically inert material are retained in a unique mounting which assures minimum torque even under high static pressure. No metal-to-metal contact. No adjustments . . . no periodic lubricating. Bearing shaft provides direct mechanical connection between float and pen . . . no lost motion . . . higher sustained accuracy. Shafts are interchangeable . . . can be replaced if damaged.

Be sure to check all the advantages that contribute to the greater accuracy of the new Foxboro Flow Meters. Write for Bulletin 460. **The Foxboro Company, 742 Neponset Avenue, Foxboro, Massachusetts.**

Available in round (shown here) and rectangular cases.

OTHER NEW BASIC ADVANCES

- **Precision Float Assembly** with stainless steel ball chain and collet-type clamp insures slip-proof, friction-free transmission of float motion to the recording pen.
- **Sure-Seal Check Floats** insure perfect seating; submerged in mercury to prevent frosting and fouling.
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- **Calibrated Damping Plug** fully adjustable under pressure.

FOXBORO REG. U. S. PAT. OFF. **... First in FLOW METERS**

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

[New Patents Affecting Petroleum Refining]

Dr. Heinz Heinemann
Compiled from U. S. Official Gazette December 2, 9, 16 and 23, 1952

Refining and Regeneration of Treating Agents—

Adsorption Process. R. P. Cahn to Stand-Oil Development Company.

In the separation of fluid hydrocarbon mixtures, particularly a gaseous mixture containing methane, C_2 and C_3 hydrocarbons, by means of a finely divided fluidized solid selective adsorbent of 50-200 microns particle size, the mixture is contacted countercurrently with the downwardly moving adsorbent. Relatively larger particles of solid, stationary packing of about the same adsorption characteristics as the moving adsorbent are maintained in at least part of the adsorption zone. Both the moving and the stationary adsorbent may be activated carbon. U.S.P. 2,620,047.

Fractional Distillation. L. Kniel to The Lummus Company.

Mixtures of light normally gaseous hydrocarbons are separated into a light and a heavy fraction in a fractional distillation operation wherein gaseous overhead is separated from liquid bottoms. The bottoms are further treated with expansion and fractionation operation. Closely boiling components are thus separated. U.S.P. 2,619,814.

Method of Separating Normal Paraffins from Isoparaffins by a Solid Adsorption Process. H. J. Hibschman to Standard Oil Development Company.

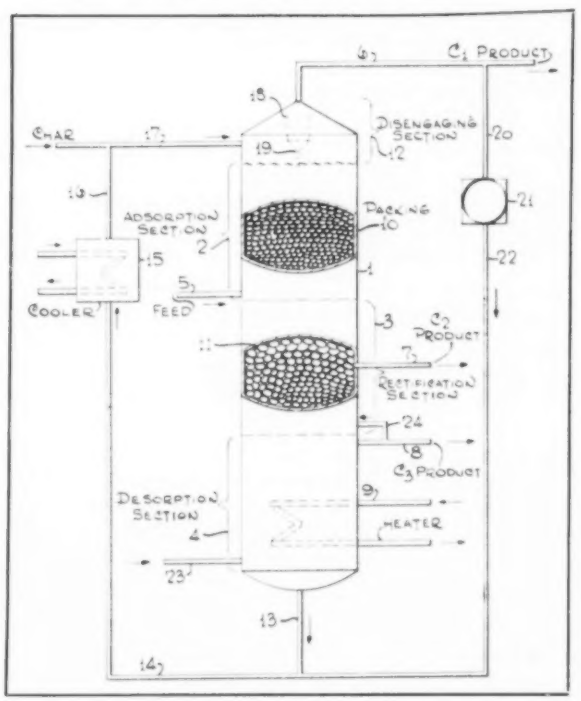
Details are claimed of a process for the segregation of normal paraffins from isoparaffins by means of solid adsorbents, such as carbon or silica gel. The adsorption process is carried out in two adsorption stages, each of which operates on a different boiling feed stock. The enriched adsorbent from each stock is washed by means of the filtrate derived from the other feed stock. The desorption and regeneration of the adsorbent is facilitated by the process. U.S.P. 2,620,363.

Separation and Dehydration of Heavy Hydrocarbons from a Gaseous Mixture. N. C. Turner to Hudson Engineering Corporation.

Heavy hydrocarbons are selectively separated from a hydrocarbon gaseous mixture by contacting this mixture first with a cold dehydrating liquid to concomitantly dehydrate and chill the gas, whereupon it is contacted with an absorbent suitable to selectively absorb the heavy hydrocarbons. Ethylene glycol may be employed as the dehydrating liquid. U.S.P. 2,620,895.

Adsorption Separation Process. J. W. Scott and S. Eagle to California Research Corporation.

A solid adsorbent is alternately contacted with a liquid hydrocarbon mixture, such as a petroleum distillate, cracked naphtha, or the like, to selectively separate an adsorbate and a percolate, and with a stripping liquid to remove the adsorbate from the adsorbent. The first effluent from the adsorbent obtained in the stripping operation and containing adsorbate, stripping liquid and some percolate is recycled into contact with the adsorbent after the feed contacting step and prior to the stripping step. U.S.P. 2,621,149.



R. P. Cahn's Adsorption process. (See patent description, top of first column.) ←

Adsorption Separation of Hydrocarbons and Oxygenated Organic Compounds. J. Q. Cope, Jr., to California Research Corporation.

The crude reaction product of a Fischer-Tropsch synthesis is contacted with a solid adsorbent to separate an adsorbate of organic oxygenated compounds from a hydrocarbon effluent. The adsorbate is desorbed with a light alcohol which is then removed from the adsorbent by contacting the latter with liquid hydrocarbon. U.S.P. 2,621,203.

Fractional Crystallization Process and Apparatus. S. C. Carney to Phillips Petroleum Company.

In the separation of a mixture which melts over a range of temperatures into a higher and a lower melting fraction, e.g. in the separation of benzene from n-hexane or of 2,3-dimethylbutane from 2,2-dimethylbutane, at least a portion of the mixture is solidified and passed as a plurality of separate masses upward through a zone containing a discontinuous liquid phase. A reflux liquid is gravitated through this zone as a discontinuous phase richer in the higher-melting fraction than the solid. A higher-melting fraction is withdrawn as solid material from an upper portion of the zone and a lower-melting fraction from a lower portion. The upper portion is heated while heat is withdrawn from the lower portion. A liquid of the composition of the higher-melting fraction is introduced to an upper portion of the zone as reflux. U.S.P. 2,622,114.

Separation of Eutectic-Forming Mixtures by Crystallization Methods. S. C. Carney to Phillips Petroleum Company.

Components of a binary mixture of organic compounds which form a binary eutectic and which are completely miscible in the liquid phase and completely immiscible in the solid phase, such as m- and p-xylenes, cis and trans butene-2, benzene and n-hexane, are separated by a process claimed in detail. U.S.P. 2,622,115.

Catalyst Preparation, Activation, And Regeneration—

Regeneration of Fluidized Iron Oxide Catalyst. W. W. Odell to Standard Oil Development Company.

Spent hot iron synthesis catalyst is suspended in a gaseous stream containing sufficient oxygen to heat the catalyst particles to at least 1100 F. by combustion of the deposited carbon. The heated particles are then separated from the gaseous medium and passed downwardly at a controlled rate in a reduction zone through a mass of incandescent small size carbonaceous solids confined in this zone as a dense fluidized bed, while passing a strongly reducing gaseous stream upwardly through this bed. U.S.P. 2,620,313.

Spheroidal Alumina. J. Hockstra to Universal Oil Products Company.

In the preparation of shaped, particularly spheroidal alumina particles useful for hydrocarbon catalysts, as adsorbents, and the like, by introducing an aluminum sol into a water-immiscible suspending

The internal parts of the soda regenerator column shown on the right, have been gradually changed to all-Monel construction to withstand the corrosive attack of spent caustic. On the elevated structure to the left of the tall column is a vapor-to-feed exchanger which contains a Monel tube bundle.

How to
Reduce Corrosion
in the
Regeneration of Caustics

Here's one process in which corrosion takes an unnecessarily heavy toll of equipment.

Many refineries, however, are rocking corrosion back on its heels.

They're using Monel for regenerator reboilers and tubes . . . for linings and internal parts of regenerator towers . . . and for pumps, piping and preheaters handling hot caustic solutions.

The results have been outstanding.

At the Shell Oil Company refinery in Wood River, Illinois, for example, a number of Monel bubble caps in a Monel tray displayed excellent resistance to corrosion during a long experimental service period. At the same time, assemblies of conventional materials were severely corroded.

As a result of the test, the internals of the column have been gradually changed to all-Monel construction, and certain sections of the shell have been Monel-lined.

Then there's the experience of a Texas refinery. Failure of the preheater tubes in their regeneration system occurred with discouraging regularity at 30-day intervals. So they replaced their Schedule 30 pipe with Schedule 40 Monel. And at last report, the thinner-walled Schedule 40 Monel had been on the job *two full years.*

In addition to Monel, there is another Inco Nickel Alloy to keep in mind for evaporator tubes and other parts of regenerator systems. Its name – Inconel. Offering good resistance to caustic alkalis containing hydrogen sulfide and mercaptans, Inconel is particularly useful for service where metal temperatures above 500° F are encountered.

Before you choose metals for use in the regeneration of caustics, make it a point to investigate Monel and Inconel. Your distributor of Inco Nickel Alloys can give you the latest information on their availability. And of course – it's usually a good idea to anticipate your requirements somewhat in advance.

For many of the facts you'll want to know about Monel and Inconel, read *Some Corrosion Problems in Petroleum Refineries.* This valuable report contains detailed information on 15 actual problems submitted to Inco's Corrosion Engineering Service for analysis. A copy is yours on request.

Always yours for the asking, too, is the help of our Corrosion Engineering Service towards solving any specific corrosion problem you may have. THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N. Y.

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medium, hexamethylene tetramine is mixed with this sol at below gelation temperature before suspending it in the gelation medium, and is held at such a temperature until it is introduced in the form of droplets into this medium. The latter is held at a gelation temperature of 120-220 F. U.S.P. 2,620,314.

Preparation of Zinc Aluminate Spinels and the Addition of Group VI Catalysts Thereto. G. R. Gilbert to Standard Oil Development Company.

A hydrocarbon conversion catalyst is prepared by dissolving ZnO in an aqueous solution of an Al-salt of a strong mineral acid, adding a basic precipitant, and impregnating the washed precipitate with a certain amount of an aqueous solution of a group VI catalytic metal compounds, whereupon the resulting mixture is dried and calcined. U.S.P. 2,623,020.

Formation of an Attrition-Resistant Fischer-Tropsch Catalyst. S. B. Sweetser, F. R. Russell and E. R. Bucker to Standard Oil Development Company.

Details are claimed of a processs for producing an attrition resistant hydrocarbon synthesis catalyst from a previously unsintered iron oxide of low mechanical strength. The catalyst is sintered in the form of small granules instead of pills in order to simplify or eliminate the grinding operation. U.S.P. 2,623,021.

Conversion, Cracking and Reforming–

Pebble Heater Apparatus. L. J. Weber to Phillips Petroleum Company.

The construction is claimed of a pebble heater to be employed in the thermal conversion of hydrocarbons and the like. U.S.P. 2,620,175.

Conversion of Oil Residua to Lighter Hydrocarbons. R. W. Blue and C. J. Engle to Phillips Petroleum Company.

Details are claimed of a process for the conversion of a hydrocarbon oil residuum to lighter hydrocarbons, e.g. to a hydrocarbon cracking stock of lower boiling range. A naphthene hydrocarbon is employed as a hydrogen donor for the conversion reaction, and a plurality of catalysts, some of which work as olefin-forming catalyst while others work as hydrogen transfer catalyst. U.S.P. 2,620,293.

Apparatus for Catalytic Conversion of Hydrocarbons. J. G. Alther to Universal Oil Products Company.

An apparatus is claimed for the catalytic conversion of hydrocarbons, such as the catalytic cracking of hydrocarbon oil to produce aviation base and/or motor gasoline of high octane rate. A turbulent fluid-like bed of subdivided solid catalyst particles is maintained in the regenerating zone of the apparatus, and these particles are transported upwardly through the reaction zone in the ascending stream of reactants and conversion products without substantial turbulence in this zone. U.S.P. 2,621,113.

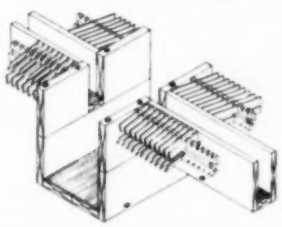
Art of Converting Hydrocarbon Material. J. W. Barker to Houdry Process Corporation.

Details are claimed of a cyclic method

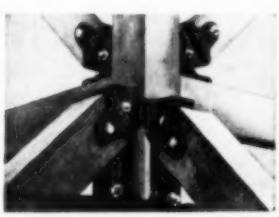
4 outstanding features in cooling towers

that insure high performance, less maintenance, and long life.

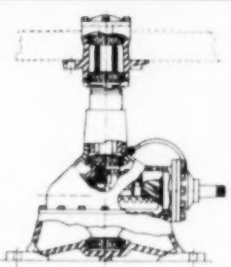
WCEC Improved Nail-less Grid Type Fill provides maximum wetted surface and maximum retardation of water to completely utilize the heat removing capacity of the air, resulting in highest cooling efficiency.



WCEC Patented Drift Eliminators efficiently remove the entrained moisture carried by the air as it leaves the tower, resulting in less water being lost.



WCEC Patented Cast Iron Timber Connectors develop the greatest structural strength of the timber joints, an accomplishment almost impossible to achieve by bolting alone.



WCEC Reduction Gears are the best type for cooling towers because their semi-floating axle prevents any weight or thrust of the fan being transmitted to the gears.

Manufacturers of various types and sizes of mechanical draft and atmospheric cooling towers.

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for the conversion of hydrocarbons, wherein solid contact material gravitates through separate conversion and regeneration zones and wherein elevated pressure exists at the upper end of the conversion zone. U.S.P. 2,621,148.

Method and Apparatus for the Thermolytic Decomposition of Heavy Liquid Hydrocarbons. F. M. Mora, Buenos Aires.

In the cracking of tar or the like, a film of the material to be treated is sprayed against a surface heated to cracking temperature. The film is retained on the heated surface, and the locus of spray is progressively moved. Solid residues are progressively removed from the heated surface while the cracked vapors are recovered. U.S.P. 2,621,150.

Coal and the Like. F. Carlsson and E. A. Eklund to Ingeniorsbyran Fredca Aktiebolay.

Bituminous oil shale or other carbonaceous material is subjected to dry distillation in a process, details of which are claimed. U.S.P. 2,621,151.

Regenerative Aluminum Chloride Process. K. K. Kearby to Standard Oil Development Company.

Details are claimed of a process for the treatment of petroleum hydrocarbons with $AlCl_3$, the main object of the process being to prevent excessive loss of the catalyst which is supported on a solid carrier. U.S.P. 2,623,009.

Oil Coker. A. H. Schutte to The Lummus Company.

In the coking of heavy hydrocarbon oil a mixture of fuel gas and air is introduced in combustion proportions with a minimum of excess air into the smallest part of a throat-portion arranged above the calcining section of a vertical reaction chamber. By burning the fuel gas, an upwardly moving mass of hot combustion gases is formed. Particles of the heavy oil are introduced into the upper part of the moving mass in the central portion of an outwardly expanding elutriator section extending above the throat portion. Coke particles are formed therein. The velocity of the mass of gases is controlled so that coke particles above a certain size drop into a bottom coke collector and calcining section. The collected coke particles are maintained by steam in a turblent dense-phase bed and are withdrawn as product from the lower part of the collector. U.S.P. 2,623,010.

Isomerization—

Synthetic Lubricating Oil. J. A. Anderson to Standard Oil Company (Indiana).

Alpha olefins having 15-25 C atoms are isomerized by contact with a solid alumina catalyst at a temperature of 300-650 F. under a pressure between atmospheric and 50 psi. with a space velocity of 1-100 volumes of oil per hour per volume of catalyst. This isomerization substantially lowers the pour point of the material. The thus treated olefinic material is then polymerized with a Friedel-Crafts catalyst, and a lubricating oil of high viscosity index and low pour point is obtained. U.S.P. 2,620,365.

Isomerization of Saturated Hydrocarbons with Sulfuric Acid. A. K. Roebuck and B. L. Evering to Standard Oil Company (Indiana).

Special types of saturated hydrocarbons, such as a stearo-isomeric dimethylcyclohexane, containing isomerization-inhibiting impurities are first contacted with spent sulfuric acid from a preceding isomerizing operation. The thus purified hydrocarbon is contacted for isomerization with a catalytic amount of H_2SO_4 of 99-99.8 percent at isomerization temperature. The withdrawn spent sulfuric acid having an acidity of 91-99 percent H_2SO_4 is at least partially recycled to the purifying step. U.S.P. 2,623,076.

Alkylation—

Method of Converting Hydrocarbons in the Presence of a Stabilized Phosphoric Acid Catalyst. J. H. Karchmer to Standard Oil Development Company.

Hydrocarbon alkylation and/or polymerization is carried out by contacting an olefin-containing hydrocarbon feed at a temperature of 280-600 F. and at least atmospheric pressure with an ortho- or pyro-phosphoric acid catalyst stabilized by 0.2-10 percent (of the acid) of an oxide of the metals below phosphorus in the right-hand column of Group V of the periodic table U.S.P. 2,620,361.

Production of Lubricating Oil. C. M. VanBattum to Shell Development Company.

A mixture of aromatic hydrocarbons boiling in the kerosene range and a mixture of predominantly straight chain olefins with 8-18 C atoms are each separated into a lower boiling and a higher

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PETROLEUM CHEMICALS DIVISION

NEWS

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February ★ *One of a Series of Interest to the Petroleum Industry* ★ *1953*

TECHNICAL MANAGER OF PETROLEUM CHEMICALS DIVISION

JOHN R. SABINA joined the Du Pont Company in 1937 after many years of development work in motor fuels and lubricants. He is a graduate of the University of Pennsylvania with a B.S. degree in electrical engineering.

After two years as an electrical engineer for the Baldwin Locomotive Works in Philadelphia, Sabina joined the Atlantic Refining Company in 1925 as a test engineer. There he developed the first audio-electrical device for measuring detonation in internal combustion engines. In 1936 he was named manager of Atlantic's Automotive Laboratory.

Sabina came to Du Pont initially to head a new group formed in the Organic Chemicals Department to develop chemicals for the petroleum industry. One of his first projects at Du Pont was designing the Petroleum Chemicals Laboratory at Deepwater Point, N. J. He became manager of this laboratory in 1938.

In 1944 he was transferred to Wilmington as manager of the Petroleum Chemicals Section of the Alcohol Division, in charge of both sales and development. When the present Petroleum Chemicals Division was formed in 1946 to manufacture and market all Du Pont petroleum additives including tetraethyl lead, Sabina was

JOHN R. SABINA

named technical manager of the new division.

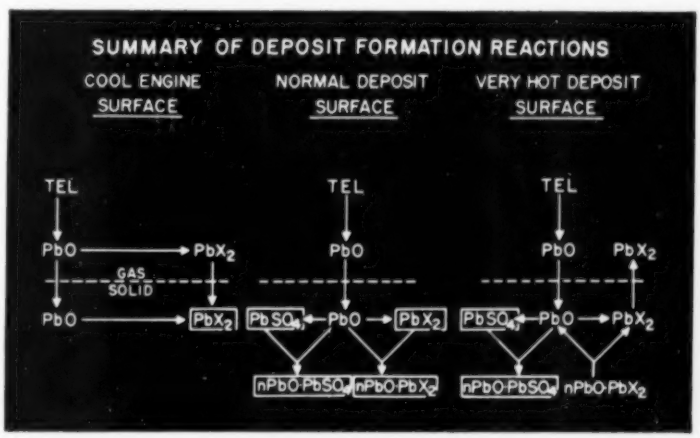
During World War II, he served as chairman of a Coordinating Research Council group formed to advise the armed services on gasoline storage stability problems. He has written numerous technical articles and papers for scientific publications and been especially active in the American Society for Testing Materials, the Society of Automotive Engineers and the Coordinating Research Council and the A.P.I. In 1944 he was elected vice president in charge of fuels and lubricants for the S.A.E.

Investigating the "How" and "Why" of Engine Deposit Formation

Studies at the Du Pont Petroleum Laboratory reveal the sequence of chemical reactions which occur in engine deposit formation.

The deposits which form on combustion chamber walls increase the tendency of fuels to knock.

This fact has long been known to petroleum and automotive engineers. But very little was known about the reaction mechanisms which result in the accumulation of these deposits—especially with fuels containing tetraethyl lead. And nearly all modern automotive fuels contain this compound.



THIS CHART SHOWS the compounds found in the deposit and the reactions by which they are produced under each of the temperature conditions studied.

Since Du Pont is a large supplier of tetraethyl lead, the Du Pont Petroleum Laboratory undertook a study of the reactions leading to the formation of the lead salt portion of combustion chamber deposits.

SMALL AMOUNT REMAINS

Although almost all tetraethyl lead decomposition products are removed from the combustion chamber with the exhaust gases, a small amount remains on the chamber walls in the form of inorganic lead salts.

Many of these salts are formed as a result of chemical reactions which occur in the combustion chamber after the fuel-air charge is burned.

In the studies, it was first determined that the reactions *might* influence deposit formation during any of the following stages:

1. Combustion.
2. Vapor state reactions following combustion.
3. Condensation of lead compounds

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED *Deposit Studies*

on cylinder wall.
4. Gas-solid reactions between lead salts and chamber gases.
5. Solid state reactions between lead salts in deposit.
6. Vaporization of lead salts.

The question then was, *how* do these reactions influence deposit formation?

TEMPERATURE INFLUENCE

After studying each of these stages in the reaction sequence shown, the Petroleum Laboratory arrived at the following conclusions:

The course of the reaction is dependent on the temperature of the combustion chamber walls.

When the walls are clean and relatively cool (ca. 200°C.), the reactions result in lead halide deposit formation. But after deposit growth has produced an insulating area, the surfaces are hotter and a variety of higher melting compounds are formed. When areas of the combustion chamber, such as the exhaust valve, become very hot, the deposit composition changes so that only very high melting compounds are formed.

GASEOUS LEAD OXIDE

Gaseous lead oxide, produced from the decomposition of tetraethyl lead, does not undergo vapor state reactions except when the gas layer near a clean combustion chamber surface is cool. Under these special and transitory conditions, it may be converted by hydrogen halides into gaseous lead halides.

Section of a single-cylinder engine room in the Du Pont Petroleum Laboratory.

(Continued in next column)

SOLID LEAD OXIDE

Solid lead oxide has a short life as a deposit constituent. It is attacked by acid gases to form simple lead salts or reacts with the simple lead salts in solid state reactions to form complex lead oxysalts.

ONE OF A CONTINUING SERIES

This Du Pont study was one of a continuing series of systematic investigations on the mechanisms causing combustion chamber deposits. It is expected that it will be of considerable value to petroleum engineers who are now charting the course of developments aimed at preventing, or at least reducing, deposit formation.

The results of these studies will be made available by the American Chemical Society and the Du Pont Petroleum Chemicals Division.

NEW BOOKLET ON GASOLINE DYES

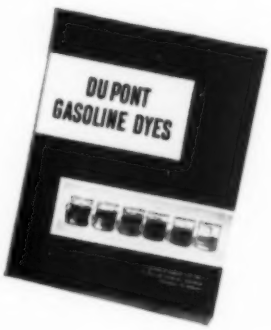
One summer day at the beginning of World War I, the German submarine *Deutschland* docked in Baltimore after a long voyage from Bremen.

Her cargo, strangely, was not torpedoes—but 500 tons of dyes. These scarce chemicals were eagerly snapped up by American manufacturers.

This incident points up the great dependence of our country on the German Chemical Industry before World War I. Then Du Pont embarked on the long, often discouraging task of developing a process for making dyes equal to or better than those previously made in Germany. It took 18 years and millions of dollars to make the operation successful. But the final result was an American dye industry equalled nowhere else in the world.

The efficient use of gasoline dyes presents a number of handling and addition problems. To help you solve these problems quickly and easily, Du Pont recently brought out a new manual on gasoline dyeing. All the latest methods of addition, including dry dye eductor systems, are fully discussed.

It also contains data on meeting color requirements for military, aviation and leaded motor fuels. And full information – with solubility charts and spectrophotometer curves—on the complete line of Du Pont gasoline dyes is included.



For your copy, ask your Du Pont Petroleum Chemicals representative or district office for the booklet, "Du Pont Gasoline Dyes."

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boiling fraction. The higher boiling aromatic fraction is then alkylated with the lower boiling olefin fraction, and the lower boiling aromatic fraction with the higher boiling olefin fraction. The products of the two alkylations are blended to form a lubricating oil. U.S.P. 2,622,112.

Solid Catalyst Injection Apparatus. B. J. Ferro, Jr., to Phillips Petroleum Company.

An apparatus is claimed for the introduction of solid catalyst of the Friedel-Crafts type, such as aluminum chloride, into a reaction zone in suspension in one of the reactants. The reactant, e.g. isobutane in an alkylation process, is introduced in a tangential direction in a confined space whence it withdraws a suitable amount of the solid catalyst to be fed to the reaction zone. U.S.P. 2,622,935.

Polymerization—

Polymerization of Styrene with Cyclic Succinoyl Peroxide. H. F. Park to Monsanto Chemical Company.

The mass polymerization of stylene is carried out at 100-400 C. for 5-30 minutes in contact with cyclic succinoyl peroxide. U.S.P. 2,620,330.

Polymerization of Olefins with a Boron Phosphate Catalyst. R. C. Krug to The Atlantic Refining Company.

Aliphatic mono-olefins with 3-10 C atoms are contacted with a boron phosphate catalyst at a temperature of 150-600 F. at a space velocity of 0.5-3 volumes of mono-olefin per volume of catalyst per hour. Olefin polymers are obtained. U.S.P. 2,620,364.

Process for Polymerizing Alpha-Methyl Styrene. G. D. Jones to The Dow Chemical Company.

Alpha-methyl styrene is polymerized at a temperature between 0 and 30 C. while in admixture with finely divided metallic sodium in the absence of an inert liquid. A solid polymer is obtained, the mole weight of which corresponds to an intrinsic viscosity in toluene greater than 0.4. U.S.P. 2,621,171.

Catalytic Polymerization with Pinacolone Peroxide. H. F. Park and H. A. Walter to Monsanto Chemical Company.

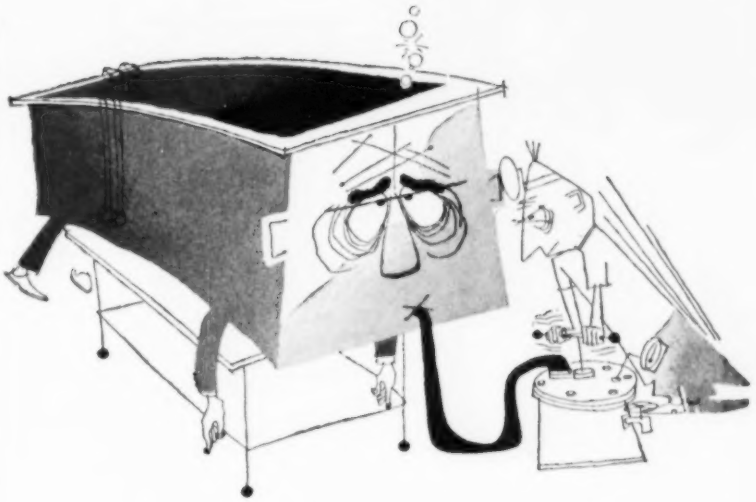
Ethylenically unsaturated hydrocarbons, such as styrene, are polymerized in the presence of pinacolone peroxide at a temperature above 100 C. U.S.P. 2,622,077.

Production of Drying Oils. H. S. Bloch and R. C. Wackher to Universal Oil Products Company.

A mixture of one mole proportion of a certain type of carbonyl compound and 1-50 mole proportions of a mono-olefin with at least three C atoms is mixed 0.1-10 parts by weight of HF at a temperature of 0-175 C. By polymerization, condensation and hydrogen exchange a saturated drying and a saturated hydrocarbon material are formed. U.S.P. 2,622,108 and 2,622,109.

Production of Long Chain Olefinic Hydrocarbons by Polymerization. G. L. Hervert to Universal Oil Products Company.

An olefinic fraction predominantly containing C_4 olefins is catalytically



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It's a waste of costly time to pump out the solution every time your process heating and cooling tanks get indigestion due to pipe coil troubles. You can save this cost and eliminate production bottlenecks by replacing the pipe coils with Platecoils. Platecoils can be removed and replaced **without dumping the solution.** They simplify maintenance and save hours of downtime. They heat or cool 50% faster and take 50% less space in the tank. As revolutionary as the new wonder drugs, Platecoils cure production troubles involving heat transfer . . . and give profits a shot in the arm.

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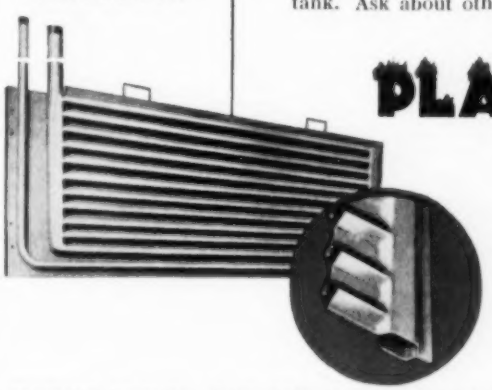

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*

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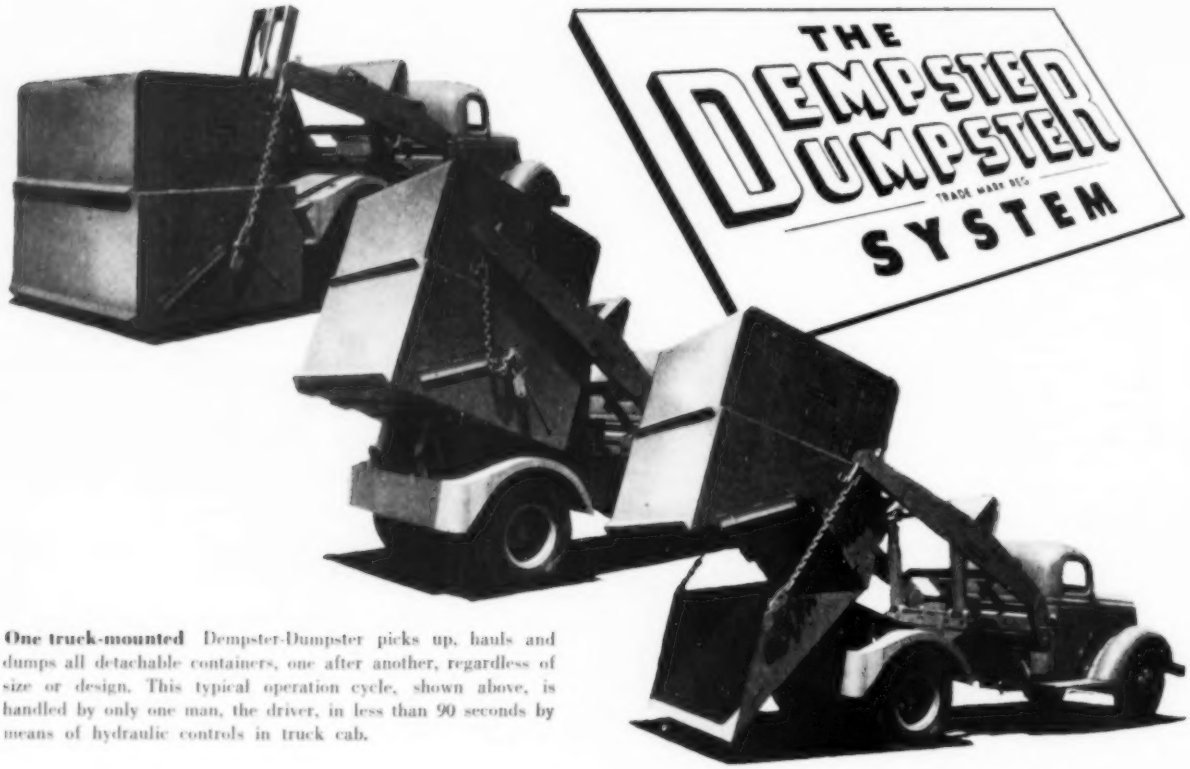
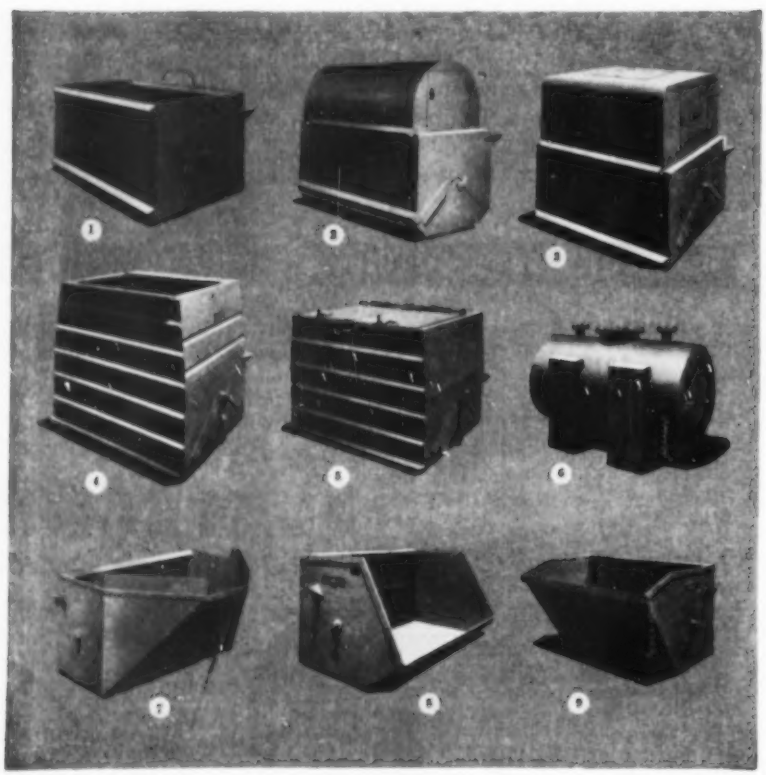


One truck-mounted Dempster-Dumpster picks up, hauls and dumps all detachable containers, one after another, regardless of size or design. This typical operation cycle, shown above, is handled by only one man, the driver, in less than 90 seconds by means of hydraulic controls in truck cab.



1—Cuts Cost of Equipment and Operation— It is not unusual for one Dempster-Dumpster to perform the work of from 3 to 5 conventional trucks . . . reducing investment accordingly. Eliminating trucks also means eliminating tires, gas, oil, maintenance and man hours.

3—Eliminates Re-Handling of Materials — Re-handling of materials, which by conventional methods are hand loaded by loading crews into dump trucks, is eliminated. Each detachable container remains at its convenient location until loaded. Then, in less than a minute, it is picked up by Dempster-Dumpster and taken to destination. There it is dumped or set down intact . . . saving hundreds of man hours annually.

• • •

At left are a few standard containers for general requirements— 1—Drop Bottom Container built up to 10 cu. yd. capacity to handle heavy materials. 2—Apartment Type for bulk trash and rubbish with sump bottom for handling moist materials. 3—Universal Type available with top and end doors. 4—Drop Bottom Pressed Steel Type for lighter service. 5—Drop Bottom Pressed Steel Type with counterbalanced spring lids. 6—Tank Type Container meeting A.S.M.E. specifications. Capacities up to 1,200 gallons. 7—Tilt Type with Converged Lip for handling fine aggregate, wet or fluid materials. 8—Skip Type with Lip to assist in holding certain types of loaded materials in place. 9—Tilt Type for handling heavy materials. Built water-tight.

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The fundamental reason why the Dempster-Dumpster System is the most efficient method of materials handling by truck is because, in this system, one truck serves scores of detachable containers. In other words, a truck-mounted Dempster-Dumpster . . . with only one man, the driver . . . picks up, hauls, dumps or sets down intact . . . one after another . . . any required number of big Dempster-Dumpster Containers.

The hydraulically operated Dempster-Dumpster is mounted on any make truck chassis of suitable size.

The steel containers are available in a wide variety of designs best suited to the type of materials handled—be they bulky, light or heavy . . . solids, liquids or dust . . . trash or rubbish. They range in size up to more than three times the capacity of the average dump truck body. The containers are spotted inside and outside your plant at convenient materials accumulation points. A few of the dozens of detachable containers are shown here so that you may see the flexibility of this system in handling all types of materials in your plant with one truck. It may be that none of these containers will fit your own particular need. But remember there are Dempster-Dumpster Containers that will, either standard or special design.

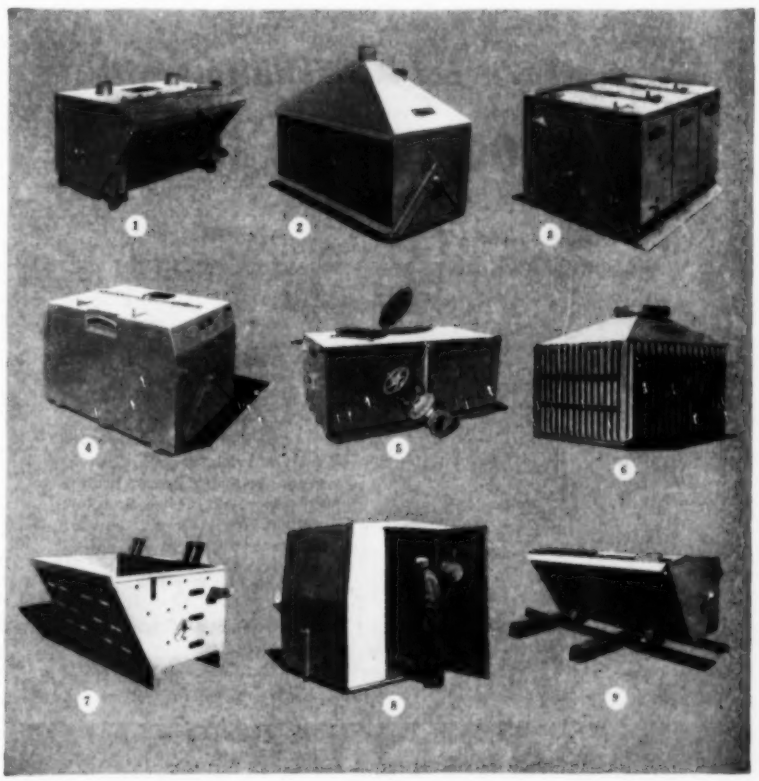
More efficient and lower cost materials handling in your plant may be simply a matter of getting the probing minds of your engineers and ours together. Our files contain hundreds of inquiring letters that ultimately resulted in savings of thousands of dollars annually in every conceivable type of manufacturing plant. A discussion with our engineers might develop the same results for you. If advisable, they will be glad to make, without obligation on your part, a proper survey to determine just what equipment you may need. The Dempster-Dumpster System is manufactured exclusively by Dempster Brothers, Inc.

2—Eliminates Standing Idle Time—One man, the truck driver, replaces truck loading crew. Detachable containers are pre-loaded through normal accumulation. Truck-mounted Dempster-Dumpster and driver never stand idle because there is always a pre-loaded detachable container to be serviced.

4—Increases Efficiency, Sanitation and Good "Housekeeping"—The Demp-Dumpster System is a complete, unified plan for area-wide materials handling. Materials to be disposed of or transferred are placed in a nearby container as they accumulate. Containers used for trash and rubbish are fire-proof, rat-proof and fly-proof. No other method of materials handling by truck can match the Dempster-Dumpster System in efficiency and low operating cost!

• • •

At right are a few containers built for special requirements— 1—Five cu. yd. container with swivel casters for handling waste blast sand. 2—Three cu. yd. Dust Collector Type equipped with gaskets. 3—Multi-Karry Container equipped with three 2 cu. yd. steel boxes with casters and lids. 4—Six cu. yd. drop bottom container with two spring-hinged lids and special loading opening in top. 5—Rectangular Tank Type Container with gate valve and gasketed Lid. 6—Chlorinator Ash Container designed for handling hot residue approximately 1500° F. 7—Tilt Type Container built for cast linings for handling hot materials. 8—One of several special "Tool and Equipment" Type Containers. 9—One of several types of special built containers equipped with ball bearing trucks.



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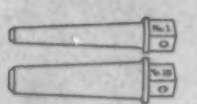
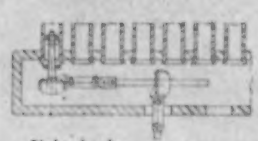


Short Mandrels



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polymerized. The resulting olefinic products are mixed with a predominantly C_4 hydrocarbon fraction containing propylene. This mixture is further catalytically polymerized to obtain C_{12} to C_{18} olefins. U.S.P. 2,622,113.

Two-Stage Emulsion Polymerization Process. F. W. Banes and E. Arundale to Standard Oil Development Company.

Rubber-like polymers are produced by emulsifying specific amounts of a conjugated olefin having 4-6C atoms and specific types of nitriles, such as acrylonitrile, in an aqueous medium, partially polymerizing the emulsion in the presence of an oxygen-liberating catalyst, adding further nitrile thereto, and then continuing the polymerization. U.S.P. 2,623,032.

Hydrogenation, Dehydrogenation, Aromatization—

Production of Ethylene. R. W. White to Shell Development Company.

Ethylene is produced from a sour refinery cracked gas stream containing C_1 and C_3 hydrocarbons as the principal hydrocarbon components, by a process claimed in detail. U.S.P. 2,621,216.

Production of Di (Cycloalkyl) Alkanes. V. N. Ipatieff and H. Pines to Universal Oil Products Company.

A diaryalkane hydrocarbon of specific constitution is catalytically hydrogenated at a temperature of 150-400 C. and a pressure up to 200 atmospheres to produce a di (cycloalkyl) alkane hydrocarbon. U.S.P. 2,622,110.

Catalytic Hydrogenation of Unsaturated Compounds. V. Haensel to Universal Oil Products Company.

An unsaturated hydrocarbon, such as benzene, is contacted at hydrogenating conditons with hydrogen and a catalyst prepared from an inorganic oxide carrier, such as silica, by treating the carrier with a solution of a normally solid aromatic hydrocarbon, such as diphenyl, and then compositing it with platinum or the like. U.S.P. 2,622,111.

Hydrocarbon Synthesis—

System for Synthesis from Hydrogen and Carbon Monoxide with Fluidized Catalyst. K. L. Hujsak, M. B. Kratzer and R. Mungen to Stanolind Oil and Gas Company.

The construction is claimed of a contacting and heat-exchanging apparatus useful in the synthesis of hydrocarbons and the like from a H_2/CO mixture in the presence of a fluidized catalyst, particularly a promoted iron catalyst. The reactor prevents longitudinal mixing of the fluidized solids from the top to the bottom of the reactor. The incoming synthesis gas is first subjected to reducing conditions and finally to oxidizing conditons within a single reaction zone, whereby catalyst disintegration may be minimized. U.S.P. 2,620,262.

Synthesis of Organic Compounds. L. C. Rubin and H. G. McGrath to The M. W. Kellogg Company.

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flow of the CO/H_2 mixture over the synthesis catalyst is discontinued after deposition of some carbonaceous material on the catalyst, whereupon the latter is regenerated by contact with hydrogen at elevated temperature. Thereafter, the temperature of the treated catalyst is lowered below the synthesis temperature range and is then again contacted with the CO/H_2 mixture while slowly raising the catalyst temperature at the rate of 2-30 F. per hour until the synthesis temperature is reached, to thereby condition the catalyst before the synthesis reaction is rebeginning. U.S.P. 2,620,346.

Catalytic Hydrogenation of Carbon Monoxide with Iron Catalysts. W. Rottig to Ruhrchemis A. G.

Precipitated iron synthesis catalyst is activated by first passing synthesis gas over this catalyst for at least 96 hours at a temperature of 170-200 C., extracting the catalyst at this temperature to remove paraffin formed, then further passing synthesis gas over the catalyst for 100-200 hours at the said temperature and again extracting the paraffin at this temperature. The yield in high molecular hydrocarbons is increased. U.S.P. 2,620,347.

Hydrocarbon Synthesis Process with Two-Stage Coke Gasification. W. G. May and S. B. Sweetser to Standard Oil Development Company.

Water gas wherein the H_2 to CO ratio is at least 1.0 is subjected to a first synthesis treatment in the presence of a fluidized bed of iron-containing synthesis catalyst. A tail gas comprising CO_2 and having a higher H_2/CO ratio than the feed gas is withdrawn. At least a portion of the tail gas is passed to a second synthesis reaction zone. Partially spent carbonaceous solids of relatively low C content are passed from the zone of producing the water gas from carbonaceous solids and steam, to a second water gas producing zone where steam, CO_2 and free oxygen are passed thereover under water gas generating conditions. The gaseous H_2/CO mixture thus obtained is of a ratio less than unity. At least a portion of this gas mixture is passed to the second synthesis reaction zone, there to obtain a total feed gas of the desired ratio. U.S.P. 2,620,348.

Preparation of Hydrogen and Carbon Monoxide Gas Mixture. A. D. Garrison to Texaco Development Corporation.

A CO/H_2 mixture is produced by charging a stream of oxygen-containing gas to a reaction zone, charging a stream of hydrocarbon to this zone annularly about the oxygen-containing stream in sufficient amount to react with all of the oxygen with the formation of CO_2 and H_2O vapor. This mixture is then immediately contacted with additional hydrocarbon supplied as a stream annularly about the CO_2/H_2O stream to react therewith with the formation of a CO/H_2 mixture. U.S.P. 2,621,117.

Method of Reforming Natural Gas to Produce Hydrogen and Carbon Monoxide Synthesis Gas. B. J. Mayland to Phillips Petroleum Company.

A synthesis gas containing a H_2/CO ratio of 2:1 is obtained by passing a mixture of natural gas, CO_2 and steam over a reduced nickel oxide catalyst under specific conditons of space velocity

and temperature at atmospheric pressure. U.S.P. 2,622,089.

Apparatus for Hydrocarbon Synthesis. H. Z. Martin to Standard Oil Development Company.

An apparatus is claimed for the synthesis of hydrocarbons from synthesis gas. It comprises a reactor inclined at an angle of 20-45 with respect to the horizontal. The synthesis gas is introduced into the lower portion of the reactor. A fluidized bed of catalyst is supported on a horizontal grid in this portion of the reactor. Cooling tubes are arranged above the grid. U.S.P. 2,622,970.

Preparation of a Sintered Hydrocarbon-Synthesis Catalyst Bed. D. R. McAdams to Standard Oil Development Company.

A promoted iron-type hydrocarbon-synthesis catalyst is prepared in situ in a catalytic reaction zone from a particulate catalyst material containing sinterable iron. Details of the method are claimed. The sintering is carried out without fusion to obtain a porous integral block of high mechanical strength and high porosity completely occupying the cross-sectional area of the reaction zone. U.S.P. 2,623,022.

Hydrocarbon Synthesis. J. H. Arnold to Hydrocarbon Research, Inc.

In a Fischer-Tropsch synthesis in the presence of an iron catalyst at a temperature of 550-750 F. and increased pressure with the by-product formation of CO_2 and H_2O, the production of liquid organic compounds is maximized by maintaining the conditons such that CO_2 is produced at a predetermined rate, which, expressed as the percentage of the CO consumed in the reaction, does not deviate from 9-33R-0.2S by more than about 9 percent where R is the molar ratio of H_2 to CO in the synthesis gas and S is the selectivity of the catalyst for the production of liquid organic compounds. U.S.P. 2,623,057.

Process for the Synthesis of Hydrocarbons from Carbon Monoxide and Hydrogen. W. J. Mattox to Standard Oil Development Company.

In a Fischer-Tropsch synthesis in the presence of a dense, turbulent, fluidized mass of iron-group metal catalyst, the conditions are preliminary maintained such that a vaporous metal carbonyl compound is formed. A mixture of these vapors and residual synthesis gas withdrawn is contacted with a second dense, turbulent, fluidized mass of inactive carrier material of fluidizable particle size and high disintegration resistance maintained at synthesis conditons conducive to the decomposition of the carbonyl compound with deposition of the metal on the carrier. Vaporous synthetic products are withdrawn from the second mass. The mixture of metal carbonyl vapors and residual synthesis gas is treated prior to the entry into the second reaction zone with a cooled stream of carrier material withdrawn from this zone. U.S.P. 2,623,058.

Emulsions—

Apparatus for Treating Emulson Emanating from Natural Oil Wells. E. R.

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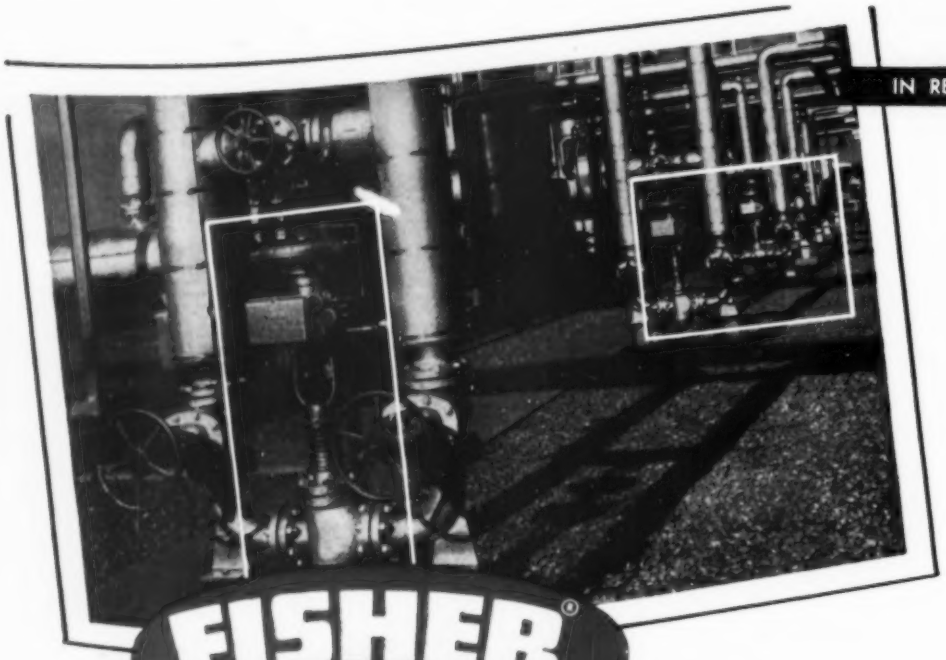

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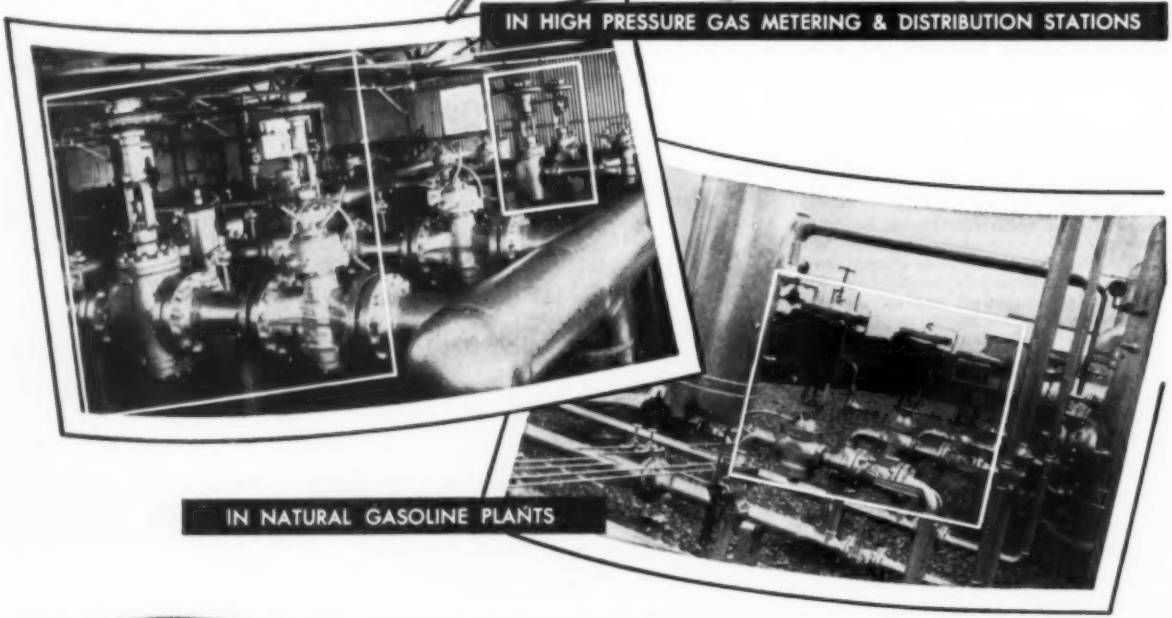

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Williams to Forrest Lee Murdock, Sr.

The construction is claimed of an apparatus for treating petroleum having water emulsified therein. U.S.P. 2,620,043.

Desulfurization—

Method of Catalytically Removing Sulfur. A. B. Stiles to E. I. du Pont de Nemours & Company, Inc.

Vaporized hydrocarbon containing sulfur contaminants is passed over a catalyst consisting of a sulfided salt of alkaline earth metals, or metals of the iron group, or silver, and vanadium, chromium, molybdenum, and tungsten, this catalyst being prepared by deposition of the salt (e.g. nickel molybdate) on a porous support and passing therethrough H_2S gas, or CS_2, or a lower alkyl mercaptan vapor. The sulfur contaminants are removed by this operation from the hydrocarbon. U.S.P. 2,620,362.

Sweetening and Stabilizing Hydrocarbon Oils. J. C. D. Oosterhout and T. C. Roddy, Jr. to The Texas Company.

Hydrocarbon oils containing mercaptan sulfur are contacted with an organic metal salt, a p-phenylenediamine, and an N-salicylalamino alkane, e.g. with copper naphthenate, N,N'-disecbutyl-p-phenylenediamine and N,N'-disalicylal-1-2-diaminopropane. Simultaneous sweetening and stabilization of the oil against oxidation is obtained by this combined treatment. U.S.P. 2,621,147.

Desulfurization of Distillate Fuels. H. Shalit to Standard Oil Company (Indiana).

A virgin gas oil containing more than 1 percent S chiefly in the form of aliphatic S-compounds is cracked to obtain a product, the 400-650 F. fraction of which contains at least .5 percent by weight of S chiefly in the form of aromatic compounds. This fraction is extracted with dimethylformamide under specific conditions to remove a very substantial portion of the aromatic S-compounds. U.S.P. 2,623,004

Desulfurization of Hydrocarbon Oil. J. McAfee to Gulf Oil Corporation.

Hydrocarbon oil containing sulfur compounds is treated in vapor form with hydrogen in the presence of a metal or oxide of the iron group deposited on a porous carrier at a temperature of 600-950 F. and a pressure of 100-1000 psi. After the formation of substantial amounts of carbonaceous material and sulfide on the catalyst, the latter is treated with hydrogen at higher temperature under pressure to convert a substantial amount of the carbonaceous material into hydrocarbon vapors without substantial conversion of the deposited sulfides, whereupon the catalyst is regenerated by combustion of the remaining carbonaceous material. U.S.P. 2,623,006.

Catalytic Desulfurization of Hydrocarbons. J. W. Myers to Phillips Petroleum Company.

A hydrocarbon fraction is desulfurized in the presence of a catalyst consisting of 30-50 percent chromia, 32-60 percent alumina, and 4-18 percent beryllia. This catalyst is pretreated at elevated tem-

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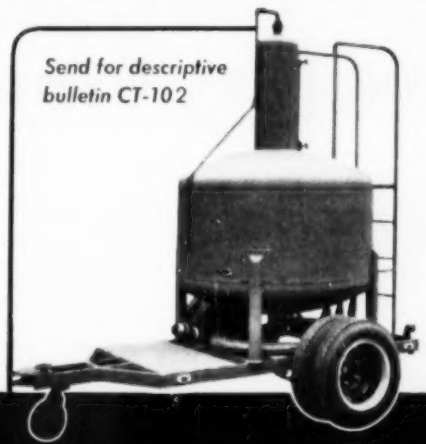

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perature with a vaporized mercaptan, thiophene or thiophane, whereby the desulfurization efficiency of the catalyst is greatly improved. U.S.P. 2,623,007.

Treatment of Sour Hydrocarbons with Caustic Solutions. L. D. Kleiss to Phillips Petroleum Company.

A sour hydrocarbon fraction is mixed, after preheating, with a caustic solution of 56-80 percent concentration at a temperature of 100-300 F. The mixture is then chilled to a temperature at which solid caustic is formed and mercaptides are precipitated therewith. The sweetened hydrocarbon is separated. U.S.P. 2,623,008.

Fuel Oils, Heavy Oils and Waxes—

Apparatus for Electrically Filtering Paraffins. K. A. Fischer.

An electrostatic filter composed of several electrically conductive filter cloths contiguous to each other and constructed in special manner serves for separating paraffinic crystals from oil and thus for dewaxing the oil. The apparatus improves the filtration velocity and provides greater efficiency in separation of wax cakes from the filter body. U.S.P. 2,620,298.

Grease Compositions. G. D. McLeod to Standard Oil Company (Indiana).

A normally liquid hydrocarbon oil is compounded with 0-1-15 percent of a water-soluble guanidine salt of a low mole weight acid, e.g. acetic or sulfuric acid, and 1-50 percent of a salt of oil-soluble petroleum sulfonic acid. A stable, thermally reversible lubricant grease is formed. U.S.P. 2,620,301.

Mercaptothiazines as Sulfur-Corrosion Inhibiting Agents. W. Lowe and J. O. Clayton to California Research Corporation.

A sulfur-containing lubricating oil severely corrosive to silver contains a small amount of a 2-mercaptothiazine or a zinc salt thereof. The mercaptothiazine shall not contain more than three aliphatic radicals having no more than eight C atoms. The additve reduces the attack of sulfur in the oil on silver. U.S.P. 2,620,303.

Lubricant. W. T. Stewart and A. Gold-Schmidt to California Research Corporation.

A lubricating oil composition composed of a special blend of hydrocarbon oil and polyalkylene glycol polymeric material of lubricating viscosity contains a minor amount of a monohydric alcohol or monothiol mercaptan with more than four aliphatic C atoms. This solubilizing additive lowers the miscibility temperature of the blend. U.S.P. 2,620,304.

Oil Compositions. W. T. Stewart and A. Goldschmidt to California Research Corporation.

The content of this patent is closely related to that of U.S.P. 2,620,304. A monoamine having at least five aliphatic C atoms is here employed as the solubilizing additive. U.S.P. 2,620,305.

Lubricating Oil Compositions. W. T. Stewart and A. Goldschmidt to California Research Corporation.

The compositions according to this patent differ from those of U.S.P. 2,620,-304 essentially in that certain polar carbonyl-containing compounds, such as carboxylic acids, their esters, ketones, or aldehydes having at least five aliphatic C atoms, are employed as the solubilizing additives. U.S.P. 2,620,306.

Lubricating Oil. W. T. Stewart and A. Goldschmidt to California Research Corporation.

Instead of the additives to be employed in accordance with U.S.P. 2,620,306, an ether with at least six aliphatic C atoms is here employed. U.S.P. 2,620,307.

Compositions for Lubrication. W. T. Stewart and A. Goldschmidt to California Research Corporation.

According to this patent, an alkylated monohydric phenol having at least five aliphatic C atoms is here employed as the solubilizing additive in a composition of the type of that of U.S.P. 2,620,304. U.S.P. 2,620,308.

Lubricant Compositions. W. T. Stewart and A. Goldschmidt to California Research Corporation.

At least one organic monohalide having at least three aliphatic C atoms is here employed as the solubilizing agent instead of those named in U.S.P. 2,620,-304. U.S.P. 2,620,309.

Lubricant. F. C. Teeter to Sinclair Re-

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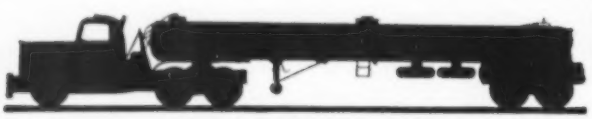
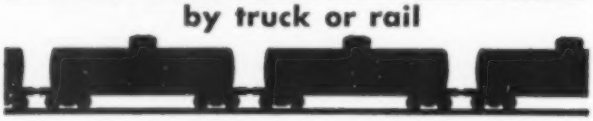


by truck or rail



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* caustic soda (FLAKE, SOLID, LIQUID)	* chlorine
* muriatic acid	* oil well and industrial salt

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fining Company.

A mineral lubricating oil contains 0.1-10 percent of a compound prepared under specific conditons from sulfur chloride and a reaction product of a bicyclic terpene, a phosphorus sulfide, and a lower alkylated monohydric phenol or alcohol. The additive has oxidation and corrosion resisting characteristics. U.S.P. 2,621,158.

Motor Fuel. R. V. White and P. S. Landis to Socony-Vacuum Oil Company, Inc.

A gasoline motor fuel contains 0.0001-1 percent by weight of the reaction product obtained from at least one aliphatic monocarboxylic acid, e.g. stearic acid, with a polyalkylene-polyamine having one more N atom per mole than there are alkylene groups in the mole and having 2-6 alkylene groups, e.g. tetraethylenepentamine, under specific conditions. The additive increases the oxidation stability of the fuel. U.S.P. 2,622,018.

Antifoamant Composition. J. A. Jehle, Jr., to Socony-Vacuum Oil Company, Inc.

A mineral lubricating oil contains 0.05-2.5 percent by weight of an antifoamant composition consisting of 1-40 percent of a mono or polyalkylene glycol and 99-60 percent of the reaction product formed from three moles of an alkylphenol with a total of 8-12 C atoms in the alkyl radicals thereof, and one mole of P_2O_5 at elevated temperature. U.S.P. 2,622,066.

Emulsifiable Oil Compositions. R. V. White and P. S. Landis to Socony-Vacuum Oil Company, Inc.

The product according to this patent is closely related to that of U.S.P. 2,622,018. The additive to a mineral lubricating oil here consists of 0.01-10 percent of the reaction product of an aliphatic carboxylic acid having 14-30 C atoms with a polyalkylenepolyamine of the type named in said patent. A water-in-oil emulsion of the oil can be formed by the presence of the additive. U.S.P. 2,622,067.

Method of Purifying a Lubricating Oil Feedstock with Zinc Halides. T. F. Rutledge and F. M. Seger to Socony-Vacuum Oil Company, Inc.

An olefinic charge stock obtained by a Fischer-Tropsch synthesis and to a substantial amount boiling between 150-500 F. is contacted with a zinc halide. The treated stock is distilled, and a distillate boiling in said range is collected. By prolonged heating a lubricant is obtained which has good color, low carbon residue and high viscosity index. U.S.P. 2,622,094.

Amino Phenols as Rich Mixture Additives. G. H. Denison, Jr. to California Research Corporation.

A spark ignition engine fuel comprises a gum-free hydrocarbon fuel boiling in the gasoline range and having an F-2 octane rating not less than 100 and containing a small amount of an N-methyl amino phenol or a nuclear C_1 to C_4 alkyl homolog thereof to improve the rich mixture anti-knock value of the fuel. U.S.P. 2,622,971.

Propane Fractionation of Lubricating Oil Stocks. W. N. Axe and A. N. DeVault to Phillips Petroleum Company.

Lubricating oil constituents from low asphalt-content reduced lubricating oil stocks are continuously fractionated with liquid propane in a process claimed in detail; the precipitation of asphalt and plugging of the aparatus thereby are avoided. U.S.P. 2,623,005.

Lubricating Oil Composition. R. W. Mertes to Union Oil Company of California.

A mineral lubricating oil useful in internal combustion engines contains a minor amount of a modified oil-soluble metal petroleum sulfonate formed by heating an oil-soluble metal petroleum sulfonate with a metal salt of a weak inorganic acid of certain characteristics to effect dehydration and to solubilize the weak acid salt in the sulfonate. Detergency characteristics are imparted to the oil by the additive. U.S.P. 2,623,016.

Gel-Type Grease. W. B. Whitney to Phillips Petroleum Company.

A grease comprises a major amount of a hydrocarbon lubricating oil and specific amounts of a mixture of a lithium soap having 12-22 C atoms and a potassium soap having 16-22 C atoms. It also contains a small amount of a free fatty acid with 12-22 C atoms. The grease has good initial penetration properties, is smooth and homogeneous, has good work stability and temperature reversibility. U.S.P. 2,623,017.

Extreme Pressure Lubricant. E. B. Cyphers and A. H. Popkin to Standard Oil Development Company.

A mineral base lubricating oil contains a minor amount of a product obtained by heating specific amounts of a certain type of a dialykl ester of a diglycol carbonate containing active chlorine with an alkali metal salt of an alkyl substituted dithiophosphoric acid. The additive imparts improved extreme pressure resisting properties to the oil. U.S.P. 2,623,018.

Petrochemicals—

Pretreatment of Cumene by Oxidation. G. G. Jorris to Allied Chemical and Dye Corporation.

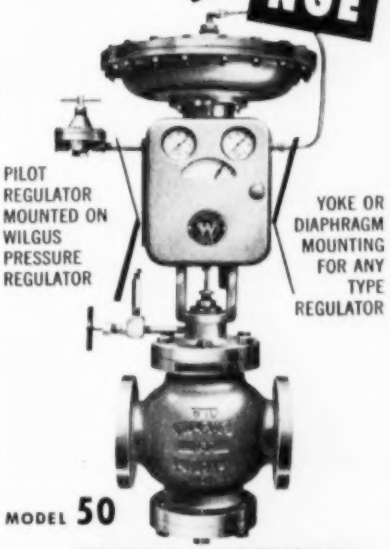
Cumene is intimately contacted in liquid phase with elemental oxygen at a temperature of 100 to 130 C, until not more than 5 percent, by weight of the reaction mixture, of cumene hydroperoxide has been formed. The treated cumene is contacted with a strong base, then separated therefrom and thereafter oxidized under corresponding conditions at temperatures not above 100 C until a concentration of at least 11 percent by weight of cumene hydroperoxide is obtained. U.S.P. 2,619,509.

Manufacture of Isopropyl Benzene Hydroperoxide. G. P. Armstrong, T. Bewley and K. H. Walter to Hercules Powder Company.

Isopropyl benzene is oxidized in the liquid state to the hydroperoxide by introducing an excess of molecular oxygen of high concentration at a temperature of 105 to 135 C. and reducing the explosion risk by the introduction of steam. U.S.P. 2,610,510.

Catalytic Oxidation of Olefins in the Presence of Cuprous Oxide. K. D. Detling and V. P. Guinn to Shell De-

Wilgus NGE



TWIN NOZZLE PILOT REGULATOR

Controls pressures up to 1000 pounds without changing Bourdon Tube...

Here is a new, simplified, pilot regulator that provides direct or reverse pilot action, by simply changing the supply and diaphragm tubes from one position to another! The Wilgus NGE twin-nozzle pilot regulator incorporates a Bourdon tube, of highly corrosive-resistant nickel alloy, to vary the flow of the pilot supply medium through a nozzle mounted in a twin-nozzle block. This combination direct-and-reverse-acting nozzle block is integral with the control setting mechanism. Simply change the supply and diaphragm tubes from one position to another, and you accomplish the desired results of reverse action in a matter of a few minutes.

Sturdy and precision made throughout. Highly sensitive yet ruggedly constructed. Fully described and illustrated in Wilgus NGE Bulletin No. 614. Write for your free copy today.

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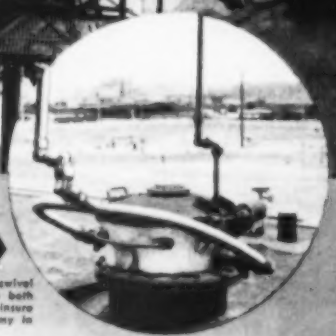
CHIKSAN ADDS SAFETY and SPEED TO LOADING OF TANK CAR AND TRUCK

With counterbalanced Chiksan loading racks, one man can quickly and easily make connections to tank cars.



CHIKSAN low pressure swivel joints employed here on both supply and return lines insure safety, speed and economy in loading tank cars.

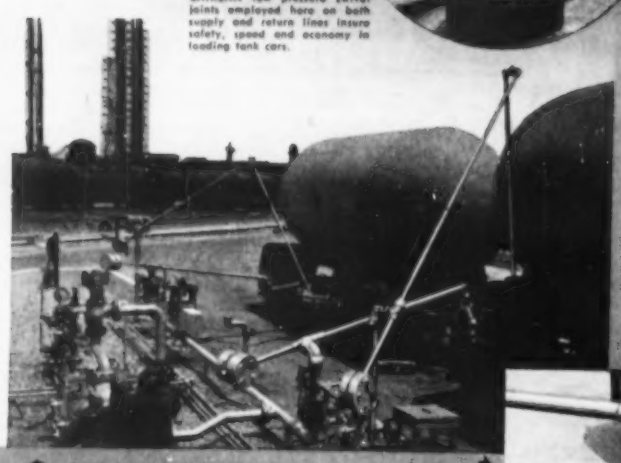
It takes speed, safety and kid-glove handling to keep up the massive flow of liquefied petroleum gas at Standard Oil Company of California's El Segundo plant.

Chiksan provides the necessary liquid-tight, gas-tight unions, the characteristic flexibility of motion to keep the touchy Butane flowing at a swift, even pace with safety to workers, plant and community — with profit to the company.

No less than eight Chiksan Ball-Bearing Swivel Joints are needed for each loading installation to keep the gas moving into tank and truck—to provide the essential carry-off of the highly explosive vapors. And with Chiksan on the job, metal of relative low porosity takes the place of more porous and less safe rubber.

Standard Oil Company of California's El Segundo installations are typical of industry's reliance on Chiksan Ball-Bearing Swivel Joints around the world to speed the flow of enterprise — to promote production and defense—to increase safety—to protect profits.

Wherever liquid or gas must flow in industry — wherever hydraulic systems can add efficiency and economy—Chiksan Ball-Bearing Swivel Joints are on the job. If more flexibility—greater stamina—longer life and added economy are of interest to you, Chiksan's Research and Development Division can help you find a better, swifter way.



A typical near ground level truck loading rack using CHIKSAN joints on supply and return lines.

Close up of CHIKSAN low pressure joints on supply and return lines in truck loading of Butane.

CHIKSAN

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velopment Company.

Unsaturated aldehydes and ketones are produced by passing a gaseous mixture of an olefin having at least three C atoms, oxygen, and an inert gas into contact with a Cu_2O catalyst under suitable conditions. After separation of unsaturated carbonylic compounds formed, the residual gaseous mixture comprising inert gas, oxygen, CO, and olefin is treated to selectively oxidize the CO to CO_2, whereupon the gaseous effluent is passed together with make-up feed to Cu_2O catalyst in order to produce further quantities of the unsaturated carbonyl compounds. U.S.P. 2,620,358.

Production of Organic Compounds. J. H. Haslam to E. I. du Pont de Nemours & Company, Inc.

Benzene, diphenyl, or naphthalene is reacted at a temperature of 60-80 C. in the presence of a titanium halide with with a long-chain unsaturated monobasic acid or a derivative thereof, containing at least eight C atoms in the chain and a double-bond C group free from conjugation with the carbonyl group. A bis organic compound is obtained. U.S.P. 2,621,192.

Production of Acrylonitrile. A. F. MacLean and D. E. Pickart to Celanese Corporation of America.

A mixture of HCN and acetylene is passed through an aqueous solution of a suitable catalyst, such as a solution of $CuCl_2$ and NH_4Cl, whereupon the mixture of reaction gases formed and of the aqueous catalyst solution is passed through benzene, toluene, diphenyl ether, diphenyl, or isomeric xylenes for absorbing the acrylonitrile formed and separating it from unreacted HCN and acetylene. U.S.P. 2,621,204.

Nitration of Olefins. T. F. Doumani, C. S. Coe, and E. C. Attane, Jr., to Union Oil Company of California.

Nitrogen oxide addition products of cyclo-olefins are produced from cyclo-olefins by means of nitrogen tetroxide in a process claimed in detail. U.S.P. 2,621,205.

Pretreatment of Aralkyl Hydrocarbons with Alkali Metal Hydroxide. G. G. Jovis to Allied Chemical & Dye Corporation.

The oxidation of commercial grade, distilled aralkyl hydrocarbon in liquid phase by oxygen to the corresponding hydroperoxide is accelerated by a pretreatment of the hydrocarbon with aqueous alkali metal hydroxide solution. U.S.P. 2,621,213.

Ethylene Oxide Production and Recovery. C. J. Thomas to Phillips Petroleum Company.

Ethylene is catalytically oxidized with an oxygen containing gas. The reaction effluent is contacted with halogenated aromatics, paraffins, cycloparaffins or ethers boiling at 35-350 C. The ethylene oxide is selectively absorbed. At least a portion of the unabsorbed gas is recycled to the oxidation operation together with a minor amount of the absorbent. The absorbent there acts as a suppressant to CO_2 formation. U.S.P. 2,622,088.

Oil-Soluble Polyvalent Metal Salts of Acids from Oxidized Hydrocarbons

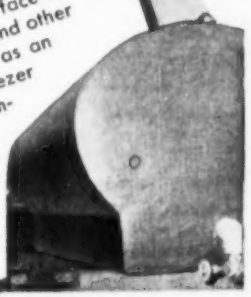
Workmen love to use foster H.I. Mastic

No other fibrated asphalt emulsion responds so easily, trowels or sprays so easily, as Foster H. I. Mastic 90-7. Workmen enjoy the smoothness of its application —and they know they won't have to patch cracks in H. I. Mastic around corners of insulated tanks and equipment, as they must do with the usual asphalt weathercoating. Easy workability makes for reduced labor costs in applied insulation.

The easy troweling and rugged durability of Foster H. I. Mastic result from specialized formulation for the job to be done; and users' confidence in H. I. Mastic is assured by our exacting care in maintaining uniformity. U.S. patent 2,129,416 protects Foster's unique combination of asbestos fibers, colloidal clay, and blended petroleum asphalts.

Ideal as a weatherproof and breathing surface on insulation for heated tanks, pipe lines, ducts, and other equipment, H. I. Mastic is also appropriate as an insulation surface coating inside cooler or freezer rooms. In fact, wherever you need an economical breathing mastic coating that won't shrink and crack from weathering, or deteriorate under rough treatment, there's a job for Foster H. I. Mastic 90-7.

Application of H. I. Mastic to interior of freezer room (Foster Specification I).



H. I. Mastic has not cracked or shrunk at this critical corner of insulated outdoor tank. Application is Foster Specification J.

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See the Foster catalog in Sweet's Plant Engineering and Industrial Construction Files for 1953

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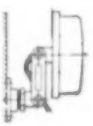
Full 4½" dial face. Stem can be placed at any angle and case can be rotated to any readable position.

1 **Rigid Stem Dial Thermometer** tapered bulb, interchangeable with standard industrial thermometer separable socket. (As illustrated above.)

2 **Wall Mounted Dial Thermometer** with flexible connecting armor. Case adjustable to easy reading position.



3 **Flush Mounted Dial Thermometer** for panel mounting with flexible connecting armor.

All three types have a full 4½" dial face.

for accuracy: Mercury actuated . . . Fully Compensated by Invar Compensaton. Guaranteed Accurate 1 scale division.

for angularity: Can be adjusted to most readable position at any angle desired.

for readability: Bold Black Numbers . . . 11" of scale Reading Dial face can always be placed in easiest readable position.

for interchangeability: Always specify "PALMER" Separable sockets as they are interchangeable for Dial or Industrial type Thermometers.

Send for Bulletin 51-129 for details on the New Palmer Dial Thermometer.

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Mfrs. of Industrial Laboratory Recording and Dial Thermometers

[New U. S. Patents]

and Process of Making Same. A. P. Kozacik and A. N. Sachanen to Socony-Vacuum Oil Company, Inc.

A hydrocarbon mixture containing upwards of 80 percent by volume of aliphatic and naphthenic hydrocarbons and boiling above 300 F. is partially oxidized. The resulting product is treated with an aqueous solution of caustic material for saponification and neutralization. The saponified and neutralized matter is separated and then acidified. The water-insoluble acidic material is treated with an aliphatic hydrocarbon solvent and the organic acidic material thus recovered is converted to a polyvalent metal salt. U.S.P. 2,622,092.

Process for Manufacture of Benzene Hexachloride. L. A. Miller, J. H. Dunn, C. M. Neher, and S. N. Hall to Ethyl Corporation.

Benzene is continuously reacted with chlorine to form benzene hexachloride dissolved in excess benzene. The resulting material is treated for purification with an aqueous caustic solution of at least 3 percent concentration and is then passed through a bed of inert fibrous material. U.S.P. 2,622,105.

Process for Reacting Ammonia and Olefins. J. W. Teter and L. E. Olson to Sinclair Refining Company.

A mixture of olefin and an excess of ammonia is reacted in contact with a catalyst consisting of a reduced mixture of Co and Mg oxides supported by diatomaceous earth in specific proportions, at a temperature of 400-725 F. and a pressure above 500 psi. U.S.P. 2,623,061.

Production of Alcohols and Gasoline by the Oxo Process. W. F. Ratcliff to Standard Oil Development Company.

Olefins are contacted with CO and H_2 in the presence of a carbonylation catalyst under such conditons that a major proportion of oxygenated products containing one more C atom than said olefin are formed. The reaction products are contacted with a hydrogenation catalyst under hydrogenating conditions. The liquid products are distilled to obtain alcohols having one C atom more than the original olefins. The bottoms of this distillation which contain higher boiling liquid products are further treated under conditions conducive to dehydration, reforming and cracking to produce a hydrocarbon product which may be cut to recover a high-octane gasoline. U.S.P. 2,623,074.

Riesz Heads Catalysis Project Of Armour Research Foundation

Armour Research Foundation of Illinois Institute of Technology has announced a new program designed to coordinate personnel and facilities especially fitted for catalysis research.

"Under the Armour Plan," William A. Casler, assistant director of research, said, "team action assures maximum performance by pooling the combined knowledge, experience and research techniques of a staff capable in many fields of science and engineering."

Heading up the project is Dr. Charles H. Riesz, recently appointed to the Armour Research Foundation staff. He had been senior chemical engineer at the Institute of Gas Technology in Chicago since 1941.

Prof. Vasili I. Komarewsky, director of the catalysis laboratory at Illinois Institute of Technology, is consultant to the group. Coordination of the work is conducted through the foundation's physical chemistry section under the supervision of Dr. John E. Barkley. Dr. Julian Glasser, research engineer in the foundation's materials and processes division, was active in establishing the new program and serves as a member of the catalysis research group.

Humphrey Named to NAM Post; Grant Gets Houston Position

Robert L. Humphrey, southwestern regional manager for the National Association of Manufacturers, has been named operations director of the association's newly established Petroleum Industry Relations activity. He will be succeeded as regional manager by Dan L. Grant, formerly assistant manager of the NAM's southeastern region.

Grant will take up his duties in the Houston post immediately.

Humphrey, a long-time Texan, will continue to work from the Houston office.

Batchelder Succeeds Lyman as Director of Cal Research Lab

Election of A. L. Lyman to the newly created post of executive vice president has been announced by the board of directors of California Research Corporation.

At the same time announcement was made that A. H. Batchelder has been elected a vice president and director of this Standard Oil Company of California subsidiary. He will also be general manager of the Cal Research laboratories at Richmond, Calif.

Lyman has been director of these laboratories since 1946, a part of the Standard organization since 1924.

Batchelder, who started with Standard in 1930, has been assistant director of the laboratories since 1946.

Stanolind Awards 13 Schools 15 Fellowships For 1953-54

Thirteen colleges and universities have been awarded 15 Stanolind Oil and Gas Company fellowships for the 1953-54 academic year.

The schools and fields of research in which the grants have been made are: University of Colorado, geology; Columbia University, geophysics; Louisiana State University, chemistry and paleontology; Oklahoma A & M. College, mechanical engineering; University of Oklahoma, petroleum engineering; University of Pennsylvania, accounting; Rice Institute, chemical engineering; St. Louis University, geophysics; Texas A. & M. College, pertoleum engineering; University of Texas, geology and petroleum engineering; University of Tulsa, petroleum engineering; Yale University, geology.

Each fellowship carries a stipend of $1500 as well as tuition and fees. All qualified students are eligible, with selection of the fellows to be made by the respective schools in cooperation with Stanolind.

Three Join Fuel Technology As Ethyl Reorganizes Section

Reorganization of the fuel technology section of Ethyl Corporation's sales department has been completed with the appointment of three new regional fuel technologists.

Jack D. Fuller, who has specialized in refinery technology work with Ethyl since 1942 and has served as the company's central region fuel technologist for the past four years, now heads up the fuel technology section as manager.

The three newly assigned technologists are C. Alon Cole, eastern region at New York; Fred P. Robinson, central region at Chicago; and Martin L. Alspaugh, southern region at Tulsa.

Cole was supervisor of light products operation at Socony-Vacuum Oil Company's Paulsboro, N. J., refinery before joining Ethyl last September. Robinson, who joined Ethyl in 1946, has been manager of the company's gasoline testing laboratories at Yorker, N. Y. Alspaugh has been with Ethyl 16 years and has been serving as research engineer at its Detroit laboratories.

California Standard to Give Over $200,000 in Student Aid

A program of aid to college students and universities totaling more than $200,000 this year has been announced by Standard Oil Company of California.

The program includes grants to five major universities, as well as graduate fellowships and undergraduate scholarships for deserving students throughout the country. It is sponsored by Standard and three of its subsidiaries: California Research Corporation, The California Company, and Standard Oil Company of Texas.

Under the present program, Massachusetts Institute of Technology will receive in this academic year a grant of $50,000 from a special fundamental research fund. Grants-in-aid of $10,000 each are made to California Institute of Technology, Stanford University, Princeton University and the University of Chicago.

Individual graduate fellowships are awarded to 31 students at 32 major universities in the U. S.

Donald Becomes Vice President In National Research Changes

Kenneth G. Donald recently became vice president and treasurer of National Research Corporation. The position of treasurer was vacant as a result of the resignation of E. Norman Staub.

Donald is currently president and director of Celanese Central, a subsidiary of the Celanese Corporation of America, where he is the executive in charge of that organization's foreign activities.

In other changes, the company has added Dr. George A. Sofer to the applied physics department as project manager and Dr. Milo P. Hnilicka, Jr., to the chemistry department as a participant in the project for the low cost reduction of metallic titanium.

Prior to joining National Research, Dr. Sofer was engaged as a research assistant at the Massachusetts Institute of Technology.

Croswell And Rae to Head Shreveport Engineering Firm

A new engineering firm known as Stracho Engineering Corporation has established headquarters in Shreveport, La., to serve the petroleum, power, chemical and allied industries in process piping and welding. The firm will also specialize in machinery and product development.

Principals of the organization are A. M. Croswell, executive vice president, and Walters S. Rae, Jr., vice president and chief engineer.

For the past two years, Croswell has been welding and project engineer for Gulf Southern Contractors on the 1200-mile pipe line expansion program of United Gas Pipe Line Company. He has more than 22 years experience in the field of welding in pipe line construction and other industrial work. In 1944 he was chief spread inspector of construction on the Big Inch pipe line for Tennessee Gas and Transmission Company.

Rae has been design engineer for the design development department of A. O. Smith Corporation since 1950, directing work in the field of special machinery, tools and products.

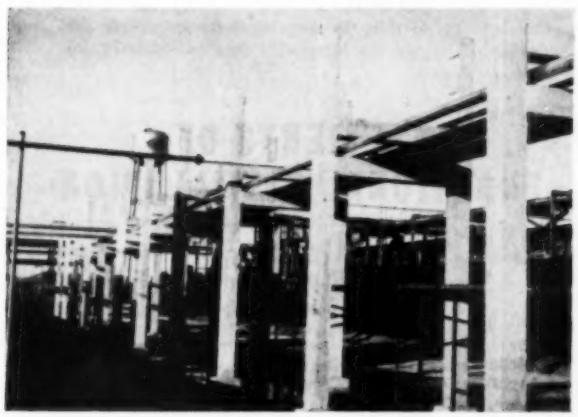
Antill Opens General Office With Corpus Christi Address

C. B. Antill and Company, engineers and constructors, has opened a general office at 4814 Ayers in Corpus Christi, Texas.

The company offers process, design, engineering, construction and operation to the gas, oil, chemical and allied industries.

Pipe Stanchion COSTS . . .
"CUT TO THE BONE!"

PRE-CAST CONCRETE PIPE STANCHIONS—A NEW, PRACTICAL IDEA IN REFINERY CONSTRUCTION!



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WIRE MESH

Maybe it all *does* look pretty much the same at first glance. But when a firm has been making wire mesh for 70 years man and boy, there's bound to be a little more to it than meets the eye — a little more know-how in engineering and weaving, a little more quality in the product, a little more service and satisfaction for the user.

JELLIFF WIRE MESH is woven in all ductile metals
JELLIFF WIRE MESH is woven in all commercial weaves
JELLIFF WIRE MESH is woven in widths up to 72 inches
JELLIFF WIRE MESH is economical. Every foot runs true to the specifications.

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[Reviewing New Books]

Test Methods For Rating Fuels

ASTM Manual of Engine Test Methods For Rating Fuels, American Society for Testing Materials, 1916 Race Street, Philadelphia 3, $8.

Incorporated into this second edition of the manual are all of the changes in the five standard methods for rating motor, aviation and diesel engine fuels that have been adopted since the earlier publication in 1948. The six supplements, extensively revised, contain information on the best practices currently in use for laboratory facilities, installation of engine test units, provisions for reference materials and electrical, water and air services, and the operation and maintenance of the units.

An important improvement in the manual is an index, which will enable users to locate needed information quickly and conveniently.

Two methods apply to motor fuels; Standard Method of Test for Knock Characteristics of Motor Fuels by the Motor Method (D 357 - 49) and Standard Method of Test for Knock Characteristics of Motor Fuels by the Research Method (D 908 - 51); two methods apply to aviation fuels: Tentative Method of Test for Knock Characteristics of Aviation Fuels by the Aviation Method (D 614 - 49 T) and Tentative Method of Test for Knock Characteristics of Aviation Fuels by the Supercharge Method (D 909 - 49 T); and the last method applies to disel fuels; Tentative Method for Test for Ignition Quality of Diesel Fuels by the Cetane Method (D 613 - 48 T).

All of the methods have come into wide use and are of great industrial significance.

Nitrogen Properties

Thermodynamic Properties of Nitrogen, O. T. Bloomer and K. N. Rao, Institute of Gas Technology, Information Service, 17 West 34th Street, Technology Center, Chicago, 16. $3.50.

Properties are presented in this IGT Research Bulletin No. 18 in tabular form and as charts of enthalpy versus entropy, and of compressibility factor as a function of temperature and pressure. The range of the tables and charts is from saturated liquid at —320.4 F. to superheated vapor at 500 F., and pressures from 10 to 1500 psia. Properties tabulated are specific volume, enthalpy, entropy and the fugacity-to-pressure ratio. For the superheated vapor region, calculations were based on zero-pressure specific heat data and a new equation of state.

The "Mollier Chart for Nitrogen" and "Compressibility Chart for Nitrogen" have been reproduced as a supplement to the bulletin; but they are issued as a set only, and are sold separately from the bulletin.

Removing Sulfur From Coke

Removal of Sulfur From Petroleum Coke, Colorado School of Mines, Golden, Colo. $.50.

This quarterly of the Colorado School of Mines is divided into two sections: a study of methods of removing sulfur from petroleum coke, by Frederick K. Sabott; and removal of sulfur from petroleum coke by pyrolysis, by William C. Schafer.

Sabott's investigation was aimed at determining some method by which the sulfur content of the coke could be reduced during the coking operation or of treating the coke after its formation in a manner which would decrease its sulfur content so as to make it suitable raw material for production of graphite electrodes.

He concludes that sulfur can be removed from petroleum coke by treatment of the coke with several different types of materials. From three different types of treatments made on the coke, he found; 1) that solvent extraction offered the simplest approach to the problem; however, the best results obtained by any solvent were far short of the desired goal; 2) that treatment of the coke with molten materials showed some sulfur removal; and 3) that treatment of the coke with gases at elevated temperatures gave results that showed industrial promise.

In his investigation, Schafer draws these conclusions:

The characteristic thermal stability of sulfur compounds in crude oils is present also in coke and residual stocks.

The presence of various atmospheres

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Massachusetts Institute of Technology

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This sound, introductory treatment covers the analysis of distillation problems from the standpoint of physical chemistry. It presents qualitative aspects from the standpoint of the Phase Rule and deals with the mathematical analysis of rectification and its application to still design.

Quantitative aspects also are covered, and a number of carefully selected examples are given of the application of principles to standard industrial distillation problems, including those of the petroleum and synthetic chemical industries.

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may or may not have an effect on the reaction.

If the reaction is influenced by various atmospheres, the data indicate that the sulfur present in coke is cyclic in character.

The absolute removal of sulfur from coke is extremely difficult and probably only possible at the high temperatures generated by a carbon arc.

Additives Developments

Additives, Petroleum Education Institute, 9020 Melrose Avenue, Los Angeles 46. $1.50.

New and late developments in the field of additives used in industrial and automotive oils and greases are described in this new pocket-size booklet.

An elementary explanation is given of: 1) the problems which are solved or relieved by use of present day additives; 2) the action of present day additives which attacks the problem to be solved; 3) how the action of present day additives serves to attack the problem; 4) the several test engines used to evaluate the merits of present day additives; 5) procedure of the "L" series and other tests used to evaluate additive type oils; and 6) the API service classification and designations for automotive-type engine oils.

Valves Specifications

Equivalent Valves, Gordon Hawes, Equivalent Valves Company, Fifth Floor, 115 West 7th Street, Los Angeles 14. $21.50, domestic; $22.50 export.

Of interest to engineers, purchasing agents and state and county officials who must specify valves or check on the specifications of others, this revised, enlarged edition compares valves of 20 leading manufacturers by material, type, pressure rating and structural variations.

With a rugged red and black leatherette cover and heavy spring closing rings, this loose-leaf manual contains over 50,000 postings of figures, names and descriptions. It shows for the first time sizes for cast steel and forged steel valves. The publisher claims that it reduces valves specification checking to one-tenth of usually required time.

Degree Work Shortened by 15 IGT Fellowships For 1953

The Institute of Gas Technology, affiliated with Illinois Institute of Technology, has announced the availability of 15 fellowships for 1953. These fellowships will lead to degrees of master of science in mechanical engineering or chemical engineering, or master of gas technology and doctor of philosophy.

The curricula for the masters of science are additions which will accelerate the fellowship program to enable the earning of a master's degree in about 15 months instead of the two years still required for the master of gas technology.

Application forms may be obtained by a student from his college department head or placement director, from the personnel manager of the local gas company, or from the director, Institute of Gas Technology, 17 West 34th Street, Technology Center, Chicago 16.

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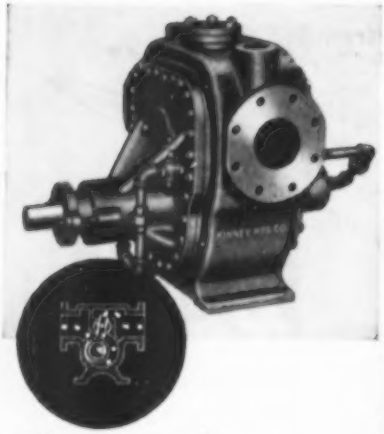

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[What Suppliers Are Doing]

Clarridge Named Chief Engineer In Taylor Instrument Changes

Ralph E. Clarridge has become chief engineer for Taylor Instrument Companies, replacing Karl H. Hubbard, who was made a technical director. Hubbard is also a member of the board of directors.

Clarridge

Howard

Succeeding Clarridge as manager of the application engineering department is George E. Howard, formerly assistant manager.

Other Taylor Instrument changes involve Robert D. Thompson, named division head in charge of research, design, methods and technical sales in the glass products division; Laurence C. Liberatore, Donald W. Shepardson and James R. Davidson, all made engineering section heads.

Clarridge started in the company's research department in 1930 as a physicist, transferring four years later to the application engineering department. Hubbard also joined the company as a researcher in 1928, becoming head of the department in 1931. He served as chief engineer from 1938 to the present.

As an application engineer, the new head of the application engineering department, Howard, has devoted himself to the textile, chemical and petroleum industries.

Standard Brass Named Distributor For Parker Appliance Fittings

Appointment of Standard Brass & Manufacturing Company as a distributor of industrial tube fittings and tube fabricating tools manufactured by The Parker Appliance Company has been announced.

Standard will maintain stocks of Parker fittings in a wide range of sizes at its Shreveport, La., headquarters. It will have specialists available for engineering assistance in the application of Parker products to hydraulic and other fluid-handling systems.

Petro-Chem Development Company Opens New, Larger Offices

In order to accommodate all expanding departments in one location, Petro-Chem Development Company, Incorporated, widely known engineers and designers of processing furnaces for the petroleum, chemical and allied industries, have moved to new headquarters in the Chanin Building at 122 E. 42nd Street, New York.

Elliott Names New Sales Manager For Crocker-Wheeler Division

Samuel K. Hostetter, Jr., has been named sales manager of the Crocker-Wheeler division of Elliott Company at Ampere, N. J.

Hostetter

Joining Elliott in 1934, Hostetter was assigned to the Washington, D. C., office as a field engineer on Elliott steam and electrical equipment. For the past ten years he has supervised Elliott sales activities in Washington and surrounding territory, in addition to covering the many federal agency activities.

American Locomotive Announces Administrative Reorganization

Appointments to new sales, administrative and manufacting posts have been announced by American Locomotive Company.

In the sales organization of its Alco Products division, A. T. Lawrance has been named regional manager in charge of sales offices located at Houston, Tulsa, Los Angeles, and at Beaumont, Texas. These duties are in addition to his present assignment as plant manager of the Beaumont Iron Works, an Alco subsidiary. Paul W. Geisler has become regional manager in charge of Alco Products sales at district offices located at New York, Dunkirk, N. Y. and Chicago. Walter E. Beline has replaced Geisler as district manager for the division at New York. L. W. Eger was appointed manager, sales-service for the division at Dunkirk.

In appointments concerning company operations, H. D. Bierau has become director of compensation and safety and G. Y. Taylor, personnel director for the company.

Appointments to new manufacturing posts include: W. J. Brockhurst as manager of material control for the company; K. C. Young as assistant manager of material control with headquarters at Schenectady, N. Y.; J. T. Lewis as manager of quality control; Mayo S. Silvey as assistant to the vice president-manufacturing; C. L. Sheen as manager, factory rebuild service; and R. E. Breen as assistant manager, factory rebuild service.

Heat Transfer Surfaces Is Subject of Trane Meetings

About 100 engineers attended meetings held recently at Wilmington, Del., and Philadelphia, Pa., where developments in heat transfer surfaces were exhibited by The Trane Company. The purpose of the meetings was to familiarize engineers with the types of extended heat transfer surfaces available for liquid-to-liquid, gas-to-gas, and gas-to-liquid heat transfer in connection with new and unusual heat transfer applications.

Consolidated Engineering Gets New Subsidiary from Eastman

Formal acquisition of the vacuum equipment of Eastman Kodak Company's distillation products industries of Rochester, N. Y., has been made by Consolidated Engineering Corporation of Pasadena, Calif.

The new company will operate under the name of Consolidated Vacuum Corporation, a wholly owned subsidiary of Consolidated Engineering. Steps are now underway to secure permanent facilities for the new company in the Rochester area.

Consolidated Vacuum will continue to manufacture the line of DPI high vacuum equipment and complete high vacuum systems, as well as the complementary line of valves, gages, pumps and pump oil.

A. O. Smith Begins Construction Of Pennsylvania Electrode Plant

Construction has begun on A. O. Smith Corporation's new electrode plant at Lancaster, Pa., which is planned for completion by late July. Built because of a rapidly expanding market for welding electrodes in the East, the single-story plant is being erected on a ten-acre site and will contain 41,000 square feet of floor space.

Space has been allowed for two production lines beginning at the mixing room and progressing through the packaging and shipping operations, which will be facilitated by proximity to both rail and trucking means.

Kemper Elected, Alexander Named By Two H. K. Porter Divisions

Election of Jackson Kemper as vice president has been announced by H. K. Porter Company. Kemper, whose background includes various engineering and sales positions, continues in his present capacity as general manager, Watson-Stillman Fittings division of the Porter Company.

In another Porter division, Quaker Rubber Corporation, J. R. Alexander has become general sales manager.

Alexander, who joined Quaker as a sales representative in 1944, is now in complete charge of the company's sales activities.

Eggelhof Gets New Consultant; Dallas Branch Gets New Offices

Eggelhof Engineers, Inc., has appointed Albert P. Woody a consultant in steam generation, combustion and boiler process heating in its Houston branch.

Woody

Woody formerly operated his own company, A. P. Woody Engineering Company, for six years was chief engineer for F. J. Evans Engineers Company for ten years and served as a construction engineer for the New Orleans Public Service Gas Department for eight years.

Eggelhof's Dallas branch recently moved into new and enlarged offices at 4331 Belmont in Dallas.

Oakite Distinguished Service Award Presented to Cunningham

Presentation of a special scroll in connection with the Distinguished Service

Award Program of Oakite Products, Inc., was made recently to L. W. Cunningham, technical service representative for the company in the Shreveport, La., area.

John A. Carter, Oakite president, made the presentation at the recent technical-sales conference for Oakite service representatives held at the Hollywood-Roosevelt Hotel in Hollywood.

Oakite's award program calls for awards to be made annually to the five members of the firm's nation-wide field organization rendering especially notable service to industry during the year.

[Company Changes]

R. L. Lloyd has been appointed general manager of advertising and **R. A. Wheeler** assistant general manager of advertising of The International Nickel Company, Inc. Lloyd has been with Inco since 1923. Wheeler became associated with International Nickel in its research department at Bayonne, N. J., in 1917 . . . The Dow Chemical Company has announced that **Royston Laboratories, Incorporated,** Pennsylvania, have been named distributors for Dow magnesium anodes, which are used for the protection of underground and underwater structures . . . **Solomon R. Baker** has been elected president of Pyrene Manufacturing Company. Pyro, Inc., of which he is also president, purchased a majority stock interest in the firm a few months ago . . . National Research Corporation recently announced the appointment of **Philip J. Clough,** a project manager with the firm since 1946, as assistant director of the National Research's metallurgical department.

Two new regional sales managers, **B. L. Lerch** and **Russell Strongman,** have been established by General Controls Company following its recent opening of a manufacturing plant in Skokie, Ill. Lerch, formerly Chicago factory branch office manager, has been appointed regional manager for the middle western territory. Strongman will supervise the eastern seaboard area . . . **Irving August,** formerly superintendent of Worthington Corporation's Denver, Colo., plant has been appointed assist-

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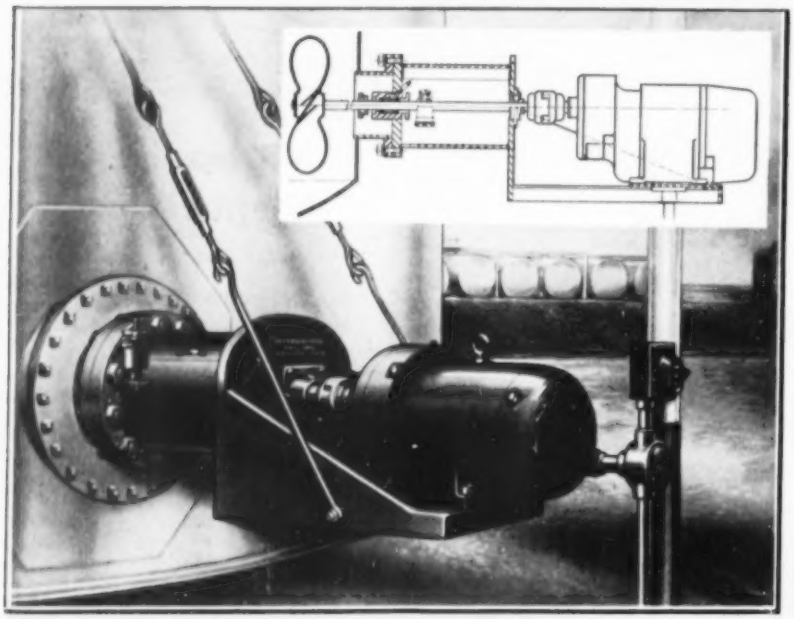

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ant to the work manager of that company's Holyoke, Mass., plant . . . **Marcus Chapman** has been appointed assistant general manager of sales-distribution, United States Steel Company, and **James P. Barton,** manager of sheet and strip sales, succeeding Chapman. Chapman started with U. S. Steel in 1919. Barton, assistant to the manager of sheet and strip sales division before taking Chapman's post, has been with the company since 1935.

Dr. E. W. Reid, president of Corn Products Refining Company and recipient of the 1951 Chemical Industry Medal, has been elected a director of American Locomotive Company . . . Insul-Mastic Corporation of America is now represented in the Territory of Hawaii by the firm of **Craig & Pullen.** Located in Honolulu, this company is the first Insul-Mastic licensee to be located outside the continental bounds of the U. S.

Appointment of **William J. Bucklee** as general sales manager of the celite division, Johns-Manville Corporation, has been announced by that company. Bucklee, a sales representative for Johns-Manville since it acquired Celite Products Corporation in 1928, succeeds **William D. Van Arnam,** retired.

Ellsworth Named Sales Director In Fluor Corporation Promotions

M. A. Ellsworth, formerly vice president of the Mid-Continent area for The

Lyon Ellsworth

Fluor Corporation, Ltd., has been appointed vice president and director of sales for Fluor. He will headquarter at the company's main office and plant in Los Angeles.

Ellsworth has been associated with Fluor for the past 11 years. Before that he was with H. H. Roths Company and Whelling Steel Company.

L. R. Lyon, formerly district engineer for Fluor's Tulsa district sales office, has been named district sales manager of the Tulsa office.

Beckman Starts Construction Of New Offices in New Jersey

Construction has begun on a new 20,000-square-foot building by Beckman Instruments, Inc., in Mountainside, N. J. To be used as eastern sales and service offices for the parent company and as an eastern manufacturing facility for the Beckman subsidiary, Helipot Corporation, the new plant will be of brick, one story high, and will be of latest design.

Sims Pump Valve Moves to Hoboken

Sims Pump Valve Company has moved into its recently purchased plant at Hoboken, N. J. The larger quarters

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Included in the brochure are Marine Propeller Agitators, Radial Propeller Agitators, Agitator Drives and an advanced Agitator Design for quick dispersion of liquids, gases and solids. Mixing equipment is shown, for solids, semi-solids, pastes and liquids. Also, drawings and data are included on custom-made pressure vessels made to standard design.

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Chiksan Increases Facilities at Brea Plant—

Office area and warehouse and assembly facilities will be increased through expansion now underway at the Chiksan Company's plant in Brea, Calif.

A large building, having 28,000 square feet of working area, will be constructed adjacent to the present main office building. It will consist of a finished material warehouse and assembly section, with an office area to accommodate the purchasing, personnel, cost accounting, price estimating, production and material control, and sales development departments. Expansion is expected to be completed by July of this year.

were necessitated by a continued high demand for Sims products.

Among the products to be manufactured at the Hoboken plant are inclined port rotating pump valves, graphitic packing rings, check valves and silent preheaters.

Stringham Succeeds Potter as G-E Commercial Vice President

Warde B. Stringham has been elected a commercial vice president of General Electric Company by the board of directors. Assigned to Washington, D. C., he succeeds Edwin E. Potter, Washington vice president of the company, who is retiring after 43 years of service.

Stringham, executive assistant to Potter, was for 13 years Washington district manager for the General Electric Supply Corporation. He was appointed a commercial vice president of that company in 1951. He left the supply corporation last year to work with Potter in Washington.

Beckman Instruments Appoints Architect to Design New Plant

Beckman Instruments, Inc., has announced that the engineering and architectural firm of Donald R. Warren Company has been retained to design the new main plant and offices which will be erected for the company in the La Habra-Fullerton, Calif., area. Plans call for an expandable design with an initial floor space of 200,000 square feet. Helipot Corporation, a wholly owned subsidiary, will also move to the new plant. The new plant will consolidate operations now carried out in the two original plants in South Pasadena.

Allis-Chalmers Returns Thorsen To Milwaukee for New Assignment

Arnold I. Thorsen, works manager, Allis-Chalmers Manufacturing Company, Norwood Works, has been appointed assistant director of manufacturing of the company's general machinery division in Milwaukee.

Thorsen returns to Milwaukee after being at the Norwood Works for 12 years. In April, 1940, he was transferred from Milwaukee to the Norwood plant as assistant works manager. Four years later he was named works manager. He joined the company in 1926 as a drill press operator.

Fritz Glitsch Names Greenman as Manager of Chicago Sales Office

Fritz W. Glitsch & Sons, Inc., Dallas, has appointed W. R. (Rog) Greenman as manager of its Chicago office, R. W. Flower, general sales manager of Glitsch, has announced.

Greenman

Greenman joined the Glitsch organization in June, 1952. He had been actively engaged in sales work in the Dallas territory prior to his new assignment. His territory comprises all of Illinois, Indiana, Wisconsin, all of Michigan except the Detroit area, all of Missouri except the western section and the western part of Kentucky.

United States Steel Division Gets New Veep, General Manager

Ralph W. Seely has been appointed vice president and general manager of the Consolidated Western Steel Division of United States Steel Corporation. He will have full responsibility and authority for all operations of the division under the general direction of the president, who continues to be the chief executive officer.

Seely has been vice president and assistant to the president of the division, with responsibility for engineering, estimating, industrial relations and other functions.

In other action by U. S. Steel, O. J. Fister has been named director of employee relations for the Oil Well Supply Division.

Fister, a veteran of more than 17 years service with U. S. Steel, joined "Oilwell" in May, 1948, serving as assistant to vice president—industrial relations at Oil City, Pa.

Ball Distributing, Engineering Company Expands Sales Territory

Ball Distributing and Engineering Company of Tulsa, distributor of Gustin-Bacon Manufacturing Company's Ultralite glass fiber insulation, has recently expanded its territory to include a ware-

house and sales office in Oklahoma City. Glenn Hughes, vice president of Ball Distributing, will be in charge of the Oklahoma City branch. Bill Linihan will be the new office manager.

GE Promotes General Managers to Executives in Decentralization

General managers of eight operating divisions of General Electric Company have been elected vice presidents by the company's board of directors.

Those elected were: James M. Crawford, general manager of the motor and generator division; Francis E. Fairman, of the transformer and allied products division; Cramer W. LaPierre, of the aircraft gas turbine division; Clarence H. Linder, of the major appliance division; Harold A. Mackinnon, of the component products division; Charles K. Rieger, of the small appliance division; Glenn B. Warren, of the turbine division; and William C. Wichman, of the industrial power components division.

Minerals Separation Forms New Company with Attapulgus Clay

Sale of the fullers earth business of the former Attapulgus Clay Company to Minerals Separation North American Corporation has been announced. The combined business now operates under the name of Attapulgus Minerals & Chemicals Corporation.

Officers of the new corporation include: David E. Lilienthal, chairman of the board; L. R. Steander, president; R. H. Hubbell, Jr., vice president in charge of sales; Dr. E. W. Greene, vice president in charge of the mineral separation division; and W. E. Sawyer, Jr., secretary and treasurer.

Childers Names Canadian Firm As New Sales Representative

The Childers Manufacturing Company has appointed Northern Heating and Insulating Reg'd., Arvida, Quebec, as sales representatives for Childers Corrugated Aluminum Jacketing in the province of Quebec. Northern Heating specializes in sales of domestic and industrial heating equipment, insulating and refrigeration equipment to the pulp and paper field, chemical plants, oil refineries and general contractors. The firm is 25 years old and headed by A. G. Joyce.

Airetool Names Duty Sales Engineer in Houston Office

Artis M. Duty has been appointed sales engineer in the Houston branch office of The Airetool Manufacturing Company, Springfield, Ohio. In his new position he will call on refineries, pipe line operators and drilling contractors to acquaint them with the Airetool line of tube cleaning and tube expanding equipment and oil refinery specialties.

Duty

Duty has a degree in mechanical engineering from Texas A. & M. and served from 1942 to 1947 in the Armored Field Artillery of the U. S. Army.

Consulting, Chief Metallurgist Named by B&W Tubular Products

Appointment of Harold D. Newell as consulting metallurgist and John J. B. Rutherford as chief metallurgist of the Tubular Products Division, The Babcock & Wilcox Company, has been announced.

Newell Rutherford

In his new post Newell, chief metallurgist since 1927, will be relieved of detail work in connection with the supervision of the laboratories' research section in order to devote his time to specific metallurgical problems. He has been with B&W since 1919 and pioneered the development of many alloy tubing steels which have since become widely used.

Rutherford, formerly assistant chief metallurgist, will now be in charge of the research section of the laboratory, process and product development and customer metallurgical service. Prior to joining B&W in 1938 he was a metallurgist with American Chain & Cable Company and U. S. Steel Corporation.

Worthington Names Managers Of Centrifugal Pump Sections

Newly-created managerial positions in the Volute Pump section, Process Pump section and Multi-Stage Pump section of the Centrifugal Pump Division have been filled according to an announcement by the Worthington Corporation.

Roy Carter will head the Volute Pump section, L. H. Garner the Process Pump section and I. J. Karassik has been appointed manager of the Multi-Stage Pump section. All three men were formery assistant to the manager of the Centrifugal Pump Division, V. Gerbereux.

Raybestos-Manhattan Opens New Office-Warehouse in Denver

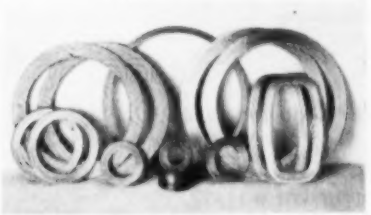
Announcement has been made by Raybestos-Manhattan, Inc., of the opening of its new Denver, Colo., warehouse. Designed for proper storage conditions and for quick truck deliveries, the building has modern office and warehouse facilities. Ample space is provided for carrying good stocks for proper servicing of the area. The new warehouse will serve the entire Rocky Mountain region as well as the Rocky Mountain and Western Canadian oil fields.

Air Reduction Company and Division Schedule Construction, Enlargement

Air Reduction Company, Inc., has announced that the capacity of its new calcium carbide plant at Calvert City, Ky., will be doubled. The additional capacity is expected to be available by early 1954.

The original plant, now nearing completion, has a rated capacity of 142,500

Need Plain or Jacketed
CORRUGATED METAL
GASKETS?



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See Page 254 in Refinery Catalog

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Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . . within the one, new NATIONAL AIROIL Dual Stage Burner. 41 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers, etc. Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed description, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

CHEMICAL-PETROLEUM DIVISION
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GAS BURNERS, FURNACE EQUIPMENT

tons per year. The increased capacity is intended to meet the increasing needs of the chemical industries for acetylene generated from calcium carbide.

Air Reduction Sales Company, a division of Air Reduction, is also planning construction of a new liquid oxygen plant in Riverton, N. J. With production scheduled to start next year, construction of the new plant will begin soon. The new plant will primarily serve the Delaware River Basin industrial area.

New Canadian Company Established

The former Canadian branch of George Kent Limited of London has terminated its operations in Toronto and has been replaced by a newly incorporated Canadian company, Kent-Norlantic Limited.

The new company will distribute, and later assemble and manufacture, domestic and industrial water meters, flow meters, flow measuring tubes for liquids and gases, and instruments and control equipment.

The board of executives includes: K. R. Wells, president and general manager; W. G. C. Howland, vice president; and R. G. Kent, who was sales director of George Kent Limited.

Brown Division Names Irwin

R. Randall Irwin has been named manager of personnel and industrial relations for the Brown Instruments Division of Minneapolis-Honeywell Regulator Company in Philadelphia.

Irwin had been with Richardson, Bellows, Henry & Company, New York industrial consultants.

New Pittsburg Division Office Opened by Research Corporation

Research Corporation, Bound Brook, N. J., has announced the opening of a new divisional office in Pittsburgh, Pa.

Richardson

H. L. Richardson has been named divisional sales manager to head the new office, which will service the western section of Pennsylvania and West Virginia. In addition to sales activities, the new office will handle all of the company's engineering services in the area.

Richardson joined Research in 1936 and has spent considerable time in Pittsburgh, both in sales and in engineering capacities.

Conoflow Names Representative

Conoflow Corporation, Philadelphia manufacturers of pneumatic control equipment, has appointed Bruce Greaves Company to represent Cono Controls in the St. Louis territory. Specializing in instrumentation and industrial power equipment, the company was founded in 1945 by Bruce Greaves, and last year James W. Bennet joined the firm. Bruce Greaves Company will service the eastern part of Missouri and southwestern Illinois with Conoflow pneumatic control equipment.

Former Eggelhof Managers Form New Manufacturers' Representative

Hudson-Rush Company is a new manufacturers' representative organization formed to handle heat transfer equipment, controls for process industries and large engine auxiliaries. The firm is a

Rush

Hudson

partnership of Morley A. Hudson and Jack W. Rush.

Hudson was formerly with Allis-Chalmers Manufacturing Company and Magnolia Petroleum Company. Rush was with E. I. du Pont de Nemours & Company, Sunray Oil Corporation and Calumet Refining Company. Prior to their association both men were division managers with Egglehof Engineers, Inc. Their offices will be in Shreveport, La., and Dallas, Texas.

Pump Manufacturers Elect Twist, Hear Discussion of Water Sources

"Underground Water Sources, their conservation, protection and use" was discussed at the semi-annual meeting of the National Association of Vertical Pump Manufacturers held recently at the Roosevelt Hotel, New Orleans.

Leland C. Kimball, sales manager, Byron Jackson Company, and retiring president of the association, reported on the association's activities of the past year. A number of papers on topics of interest to the organization and the pump industry were presented.

In the election of association officers for this year, G. F. Twist, Peerless Pump Division, Food Machinery and Chemical Corporation, became president.

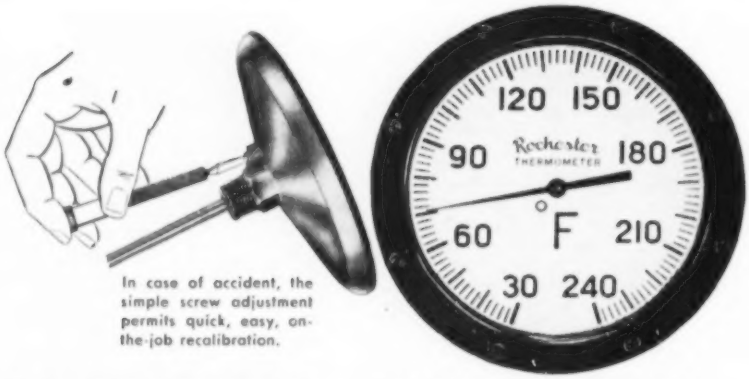
Worthington Corporation Names Engineering and Service Manager

F. E. Peltier has been appointed manager of Central Regional Engineering and Service, with offices in Cleveland, of Worthington Corporation. He will supervise the engineering and service in the company's district office territories of Detroit, Cleveland, Cincinnati, Buffalo and Pittsburgh. Peltier is a licensed Professional Engineer and a graduate of Case Institute of Technology in 1940.

Ray, Warner and Boehm Elected In Enjay Company Board Increase

Three new members have been elected to the board of directors of Enjay Company, increasing its membership to seven. They are B. L. Ray, a director and assistant general manager of marketing of Esso; J. P. Warner, general superintendent of the Baton Rouge, La., refinery; and A. Bruce Boehm, assistant general sales manager of Enjay Company.

Ray and Boehm replace L. E. Ulrope and E. H. Collins as Enjay directors. Warner, who was acting general manager of the chemical products depart-



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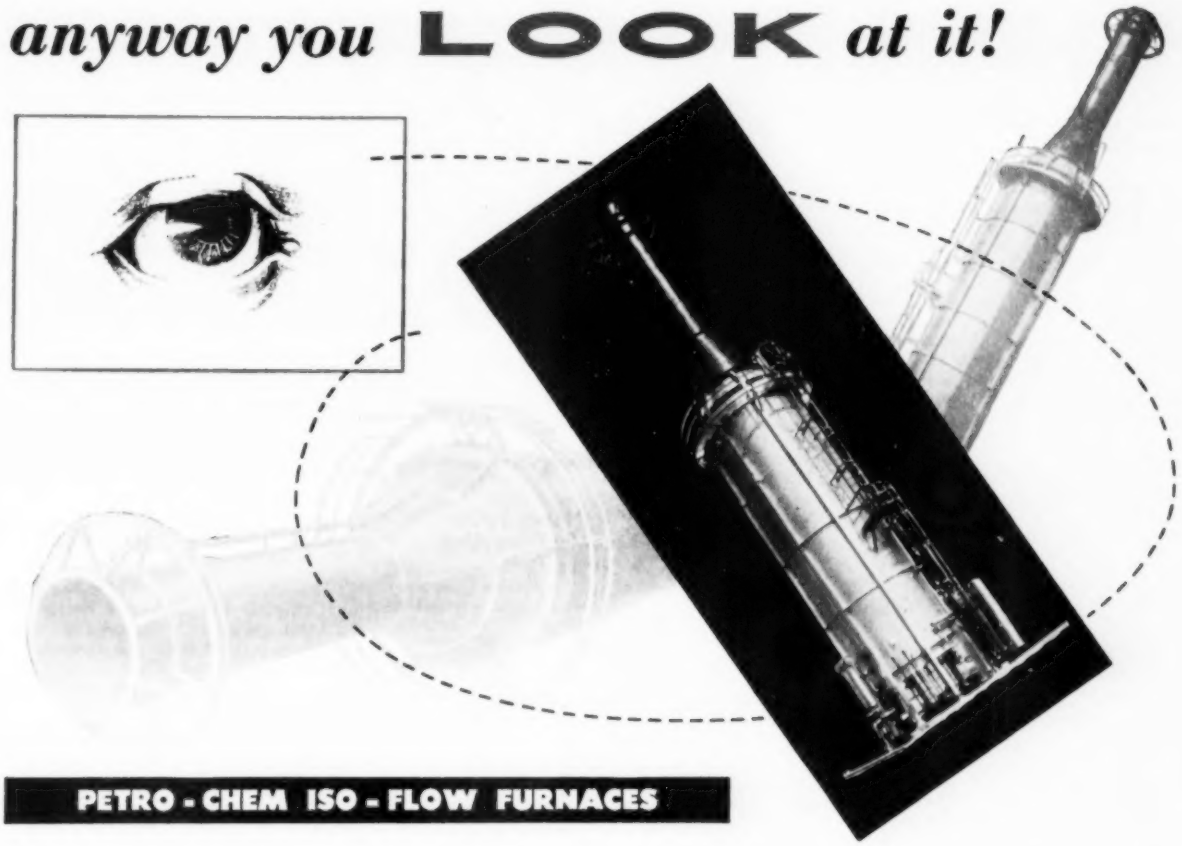

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maximum fuel efficiency

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low pressure drop

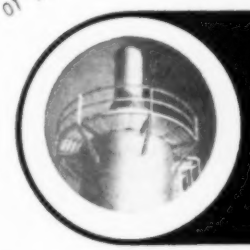
minimum ground space

better heat distribution

simplicity of design and construction

The generic design of ISO-FLOW heaters, including the reradiating cone, gives excellent heat distribution, eliminating localized overheating. Further, all walls are protected by tubes which create low wall temperatures. The walls have high insulating characteristics which create minimum outside shell temperatures, and, hence, extremely low radiation. With a radiation loss of under 2%, more heat is absorbed by the fluid being heated, resulting in higher efficiency for any type of Iso-Flow design. Since Petro-Chem has a wide variety of convection sections, all heaters can be designed for optimum fuel efficiency or for maximum fuel efficiency where the price of fuel and other economic considerations justify.

More than 1100 are in operation throughout the world in the petroleum, chemical and allied industries . . . for all processes and for any duty, pressure, temperature and efficiency . . . and all Petro-Chem Iso-Flow Furnaces are pre-eminently satisfactory.



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ment during the absence of O. V. Tracy, has also served as head of the chemical products division at Baton Rouge.

Honeywell Assigns Wishart to New General Manager Position

Paul B. Wishart, vice president in charge of manufacturing of Minneapolis-Honeywell Regulator Company's Minneapolis plants since 1945, has been appointed to the newly created position of general manager of the company. He has also been elected to the board of directors and will continue as vice president.

Before joining Honeywell in 1942, Wishart spent 19 years in various phases of the automobile business. He has had experience in both manufacturing and sales fields.

Walters Takes Rockwell Post as Houston District Sales Manager

Rockwell Manufacturing Company has appointed J. H. Walters its Houston district sales manager. In his new position, Walters is responsible for the coordination of all meter and valve sales for the company in the Houston district, which covers sections of Texas and Louisiana.

Walters

Walters became affiliated with Rockwell as a sales engineer in 1945. Prior to his recent appointment he served as Houston gas sales supervisor. He was formerly employed in the sales department of American Meter Company.

Oakite Representatives Gather in New York

Field service representatives from the Canadian, Chicago, New England, New York and Philadelphia sales divisions of Oakite Products, Inc., attended a series of technical-sales meetings recently at the Roosevelt Hotel in New York City. Featured at these meetings were reports from Oakite research chemists, service engineers and technicians on recent developments in cleaning and related procedures designed to assist industry in combatting rising operating costs.

Dravo Corporation Names Beidler General Manager Machinery Unit

John K. Beidler has been appointed general manager of the Dravo Corporation Machinery Division and elected a director and vice president of Dravo-Doyle Company, a Dravo subsidiary. Beidler joined the corporation in 1935, a year after graduating from Lehigh University, as sales engineer for industrial heating equipment in the Chicago area.

Gower Named District Manager

Dr. A. H. Gower has been named assistant district manager of the Philadelphia and Baltimore districts of the Industrial Chemicals Division of American Cyanamid. He was formerly a technical salesman for Industrial at Boston, after coming to Cyanamid in 1945.

[Company Changes]

Pennsylvania Flexible Metallic Tubing Company has appointed **Richard T. Patriquin** its New York sales manager. Patriquin started with the company as a salesman in the Philadelphia territory . . . **John W. Stevens** and **Robert W. Kampschulte** have been named, respectively, general sales manager and assistant general sales manager of the chemical division of Celanese Corporation of America. The company also appointed: **William C. Goodwine** sales manager in charge of plasticizers; **A. R. Cockran** manager of plant operations, chemical division; and **William P. Orr** assistant to manager of plant operations, chemical division. **K. D. Bowen,** formerly manager of plant operations for the division, has been promoted to the new position of director of manufacturing coordination for entire company.

Appointment of **Carlton Bates,** vice president of Solvay Process Division, Allied Chemical & Dye Corporation, as executive vice president has been announced . . . **Richard Schermer,** who joined Duriron Company, Inc., in January, 1952, as building equipment sales manager, has been named manager of pump sales for the company. **R. A. Prosser,** Chicago district manager, becomes building equipment sales manager. He is succeeded in Chicago by **Wendell A. Watkins,** Buffalo district sales manager, who is replaced by **D. E. Christie** . . . The Celite Division, Johns-Manville Corporation, has announced the following appointments: **R. J. Amberg,** who has been senior sales representative for the division at Detroit, as Cleveland district sales manager; **S. S. Childs,** formerly with the company's finance department, as comptroller of the division; **Carl Dietz,** Cleveland district sales manager, as New York district sales manager; **P. A. Martinson,** who has been senior sales representative at Minneapolis, and New York product manager for fillers; and **W. J. Petersen,** formerly comptroller of the division, as New York production engineer.

L. A. Miller Company, Louisville, Ky., has been appointed by The Davison Chemical Corporation, Baltimore, as manufacturer's agent for the sale of Syloid 308 and associated products in

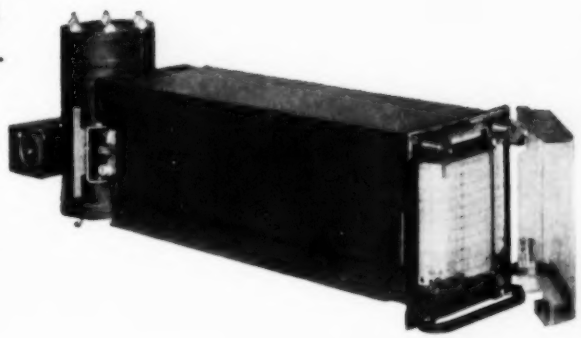
Valve Engineers Get Modernistic Home—

The two-story modernistic Engineeering Building recently erected by Edward Valves, Inc., is constructed almost entirely of stainless steel and glass. Located next to the Edward Laboratory and Research Building, the new building was built for Edward's engineering department and specially designed for its use. An entire north wall is composed of plate glass windows for maximum use of natural north light. Four-fifths of the building area is devoted to a giant drafting room, lighted by the north window and 12-foot windows on the building's west wall, supplemented by a fluorescent lighting system.

The new Taylor idea in Panel Instrumentation!

receiver mechanisms kept clean by self-purging feature!

both receiver and controller plug in like a radio tube!



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CORROSIVE atmospheres, dust or fly ash can't get into the mechanism of Taylor's TRANSET* Receivers because the protective case or sleeve is *self purging*. Even the simplest receiver can be provided with the self-purging feature. In fact, the TRANSET receivers have corrosion-resistant qualities comparable with those of the well known FULSCOPE* line of controllers, thus making them completely suitable for all industrial service. Both Receivers and Controllers plug in like a radio tube. You can change from the simplest to the most complete control by simply pulling out one unit, plugging in another.

NOTE THESE FEATURES TOO

A single mounting is all you need for both controller and recorder or indicator. *All units* can be mounted on the panel without welding, without drilling holes. And you can change from indicator to recorder, or vice versa, in only 10 seconds.

Protective sleeve or case permits both self-purging feature as well as complete mechanical protection to receiver mechanism.

The only piping connections required are air supply, controller output and to the variable transmitter. All other connections are made automatically, in the self-sealing manifold.

All adjustments on recorder or indicator can be reached conveniently, from the front, without disturbing any connections.

You save panel space, because units can be mounted only a few inches apart. **You save money,** both in labor and materials on installation, thanks to the simplified piping and mounting.

Continuous valve position indication on separate scale tells valve air pressure at a glance.

Chart read-back device gives easy access to past records without disturbing any function of the recorder or interrupting the record.

A new chart drive mechanism for greater convenience, greater dependability.

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the area around Louisville and Evansville, Ind. . . . The promotions of **P. J. McAuliffe** to purchasing agent for its Orange, Texas, plant and **J. E. Fitzgerald** to succeed him as assistant purchasing agent have been announced by United States Steel Corporation's Consolidated Western Steel Division. McAuliffe succeeds **C. H. Benckenstein, Jr.,** resigned . . . **Glenn E. Seidel** has been elected a vice president of Minneapolis-Honeywell Regulator Company in charge of engineering in the company's Minneapolis plants. Seidel, a member of Honeywell's engineering organization since 1943, has been director of the company's expanding ordnance division for the past year and a half . . . Appointment of **W. J. Hagerty** as sales manager of its chemical and process equipment division is announced by Colonial Iron Works, Cleveland. In his new position, Hagerty will work closely with engineers in the chemical, petroleum and allied industries in development of corrosion resistant processing equipment.

Hartzell C. Mills, an industrial engineer with Minneapolis Gas Company from 1933 to 1948 and since then a manufacturers' representative in the industrial field, has been named Minnesota representative for Pittsburgh Lectrodryer Corportion . . . Milton Roy Company, Philadelphia, has appointed **Tower Equipment Company** as its representative in Washington. Tower will cover all but southeastern counties . . . Calumet and Hecla Consolidated Copper Company has changed its name to **Calumet & Hecla, Inc.**

Whitney B. Miller has been appointed by Moore Products Company as manager of its Louisville branch office. Miller has been connected with the Houston branch office for the past two years as a sales engineer . . . **T. S. Dubose** has been appointed district manager of Ethyl Corporation for New Orleans, succeeding **Alan C. Tully,** who has been promoted to assistant manager of the Southern region. Dubose, formerly a field engineer in Seattle and resident manager in San Francisco, has been associated with Ethyl since 1940.

Kemp Lewis Named Baroid Manager Of Mineral and Chemical Selling

Baroid Sales Division, National Lead Company, has appointed Kemp S. Lewis manager, mineral and chemical sales.

Lewis

A chemical engineer and graduate of Rice Institute, Houston, Lewis joined Baroid as a service engineer in 1939. He served as district superintendent in the well logging department from 1941 to the time he entered the U. S. Navy in 1942.

Just prior to his recent appointment, Lewis was handling bentone sales for the company, a responsibility which will remain under his supervision.

Hammel-Dahl Appoints Sales Agent

The appointment of Control Equipment Company as an additional sales and service representative has been an-

nounced by Hammel-Dahl Company, Providence, R. I.

Robert P. Saunders, in charge of Control Equipment's sales and service, has had many years experience in process control and instrumentation.

Dewey to Manage Advertising And Sales Promotion At Fluor

Fluor Corporation, Ltd., has announced the appointment of Ed Dewey as supervisor of sales promotion for the company. For six years Dewey has been with Dozier-Eastman and Company, Los Angeles advertising agency, and for the past four years he has been account executive serving Fluor advertising, merchandising, sales promotion and a recruiting drive for skilled help in Saudi Arabia.

Dewey

Dewey received his basic sales promotion and advertising training at Columbia University, New York.

New Organization Established in Eastman Kodak Company Changes

Eastman Chemical Products, Inc., Kingsport, Tenn., has been named to market chemical products manufactured by the Tennessee Eastman and Texas Eastman divisions of Eastman Kodak Company.

J. C. Stone, formerly executive vice president of Tennessee Company, is president of the new organization.

Other appointments were: Plastics—S. E. Palmer, vice president; D. C. Williams, sales manager. Chemicals—H. L. Ford, vice president; J. E. Magoffin, sales manager. Textiles and Advertising—R. L. Churchhill, vice president; A. A. Owen, manager textile sales service; C. F. Earnhardt, Jr., manager order and planning department; and R. C. Tuttle, advertising director.

Changes in the organization at Tennessee included the election of the following officers: J. G. McNally, vice president and director of research; H. D. McNeely, vice president, R. S. Leonard, assistant vice president; Philip Farnham, assistant vice president; and R. L. Flanary, comptroller.

At Texas Eastman Company, H. H. Imray was elected vice president and E. F. Sefrna, assistant secretary.

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BUBBLE TOWERS • SETTLERS • STILLS • SEPARATORS • TANKS • AND VESSELS OF ALL TYPES • ENCASING AND FIREPROOFING STRUCTURAL STEEL AND PIPE • LINING WATER RESERVOIRS, DITCHES, DRAINS, AND CANALS • REPAIRING DISINTEGRATED CONCRETE AND OTHER MASONRY.

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RATES: Regular Classified (undisplayed) set in this size type; 10 cents per word. Minimum charge, $3. Blind box address in our care counts six words. Replies forwarded without charge. **Display ads**, set in suitably larger type with ruled border, $10 per column inch.

All classified ads payable in advance. Ten percent discount for two or more insertions of same copy in consecutive issues. COPY DEADLINE: 25th of month preceding date of issue; Send copy and remittance to: Classified Ad Department, Petroleum Refiner, P. O. Box 2608, Houston, Texas.

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I want to make arrangements to represent on a mutually satisfactory basis, probably straight commission, a Contracting Pipeline Engineering company. My territory to be Minnesota and the Dakotas. Energetic, resourceful and ambitious. Box 146-R c/o Petroleum Refiner, Houston, Texas.

■ FOR SALE: Viscosimeter, thermostatic, Saybolt, Tag ASTM D-88, one-tube, complete with tube, pipette, receiving flask, strainer, cleaning plunger, all new and unused, $250. Box 145-R, c/o Petroleum Refiner, Houston, Texas.

■ PERSONNEL DIRECTOR with 10 years of experience, presently earning $7000 a year, interested in change. Major duties in the past include job evaluation, employee relations, job placement and over-all administration. Box 147-R, c/o Petroleum Refiner, Houston, Texas.

■ PIPING ENGINEER—SALARY OPEN. Fast growing Construction Company wants PIPING ENGINEER capable of making detailed material take offs on Powerhouse, Chemical, Paper Mill and Oil Piping, and handling buying of same. Location central Southeast, most work lump sum. In experience record clearly separate engineering from actual construction experience, give salary and direct supervisor each previous job, as well as at least 4 references familiar with your work. Will pay whatever salary ability justifies. Reply Box 144-R, care Petroleum Refiner, Houston, Texas.

■ CHEMICAL OR MECHANICAL ENGINEER with at least five years experience in engineering department on design and layout of full scale chemical plants, to head up small group on this type of work. Man must have leadership ability and must be self starter. Location, downstate Illinois. Give background, references, and salary in first letter. Box 142-R, c/o Petroleum Refiner, Houston, Texas.

■ PROCESS ENGINEER—Chemical Engineer with exceptional individual initiative and 4-6 years experience in petroleum refining to assume new position with independent company located in North Texas. Send complete resume. Box 148-R c/o Petroleum Refiner, Houston, Texas.

■ CHEMICAL ENGINEER—Eleven years chemical process engineering experience involving development, design, installation and start-up. Desires responsible position in petroleum, chemical or petrochemical industry. Box 143-R, c/o Petroleum Refiner, Houston, Texas.

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Ambassador Donelly to Work in South America in U. S. Steel Job

Walter J. Donelly, resigned U. S. high commissioner for Germany, has become associated with the interests of United States Steel Corporation in Central and South America. He will live in Caracas, Venezuela.

Ambassador Donelly has won recognition during his 30 years with the U. S. Foreign Service as one of the country's leading authorities on relations with American republics.

H. O. Trerice Appoints Rogers Head of New Philadelphia Office

Albert H. Rogers, Jr. has been appointed manager of the new Philadelphia factory branch office which was opened recently by the H. O. Trerice Company. This is the fifteenth direct office opened by this manufacturer of temperature and pressure instruments, steam traps and air filters.

Kewanee-Ross Board Head Dies

Charles H. Currier, chairman of the board of Kewanee-Ross Corporation, died recently in Buffalo, N. Y. He was 66.

Currier became chairman of Kewanee-Ross when Ross Heater & Manufacturing Company, Inc., of which he was president, was recently joined with Kewanee-Boiler Corporation.

Allied Chemical & Dye Division Plans Urea Production Expansion

Plans for urea products expansion at its South Point, Ohio, plant have been announced by the nitrogen division, Allied Chemical & Dye Corporation. The $4 million project will involve doubling the plant's urea synthesis capacity, together with the installation of facilities to produce a pebbled urea fertilizer compound and an improved urea cattle feed compound.

Kellogg Establishes West Coast Warehousing Facilities for Kel-F

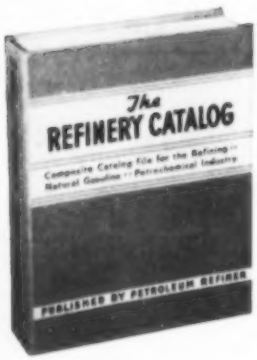
To service demands for Kel-F from industries already well established on the West Coast, The M. W. Kellogg Company, a subsidiary of Pullman Incorporated, has opened new warehousing facilities for the product in that area.

Located at Vernon, Calif., the facilities will deliver Kel-F molding powers in California, Oregon, Washington, Arizona, Nevada and Utah.

Wilson Gets New Sales Position

O. B. Wilson has been named industrial instruments sales manager for the industrial division of Minneapolis-Honeywell Regulator Company. He joined Honeywell in 1932, has been industrial manager in Chicago, New York and other offices. Early last year he was named industrial field sales manager.

[Advertisers in the February Issue]



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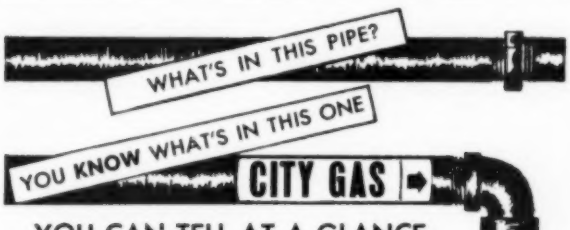

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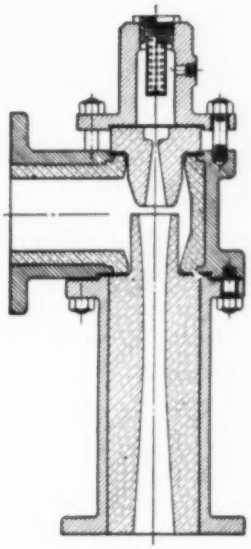

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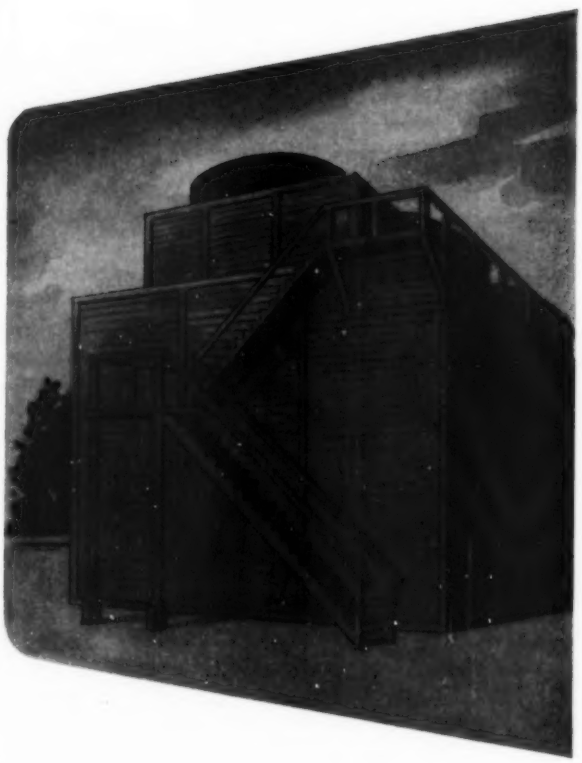

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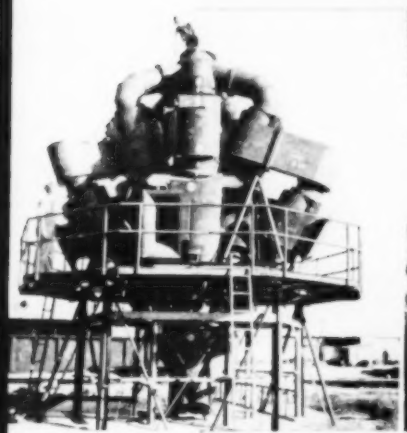

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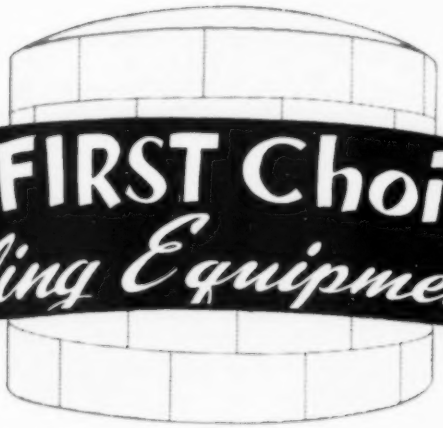

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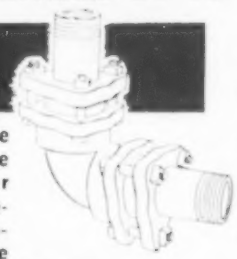

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